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GEOGRAPHICAL REVIEW

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OUR CONTRIBUTORS

PROFESSOR HOBBS is professor of geology in the University of Michigan. In the broad sphere of his interests special mention may be made of his work in seismology and glaciology, and, in connection with the latter, certain aspects of meteorology. His writings include "Earthquakes" (1907); "Characteristics of Existing Glaciers" (1911); "Earth Evolution and Its Facial Expression" (1921); "Cruises Along By-ways of the Pacific" (1925); "The Glacial Anticyclones" (1926). To the *Geographical Review* he contributed a paper on his journey to northeast Africa for the study of desert conditions (Vol. 3, 1917).

MAJOR HOLSTEIN is connected with American business interests in Peru. He has been on service in the Philippines, China, and Mexico, and took part in the World War. He is president of the recently formed archeological society of Trujillo, which is now engaged in making a plan of the ruins of Chan-Chan. Major Holstein is also carrying on meteorological observations for the American Geographical Society.

MR. SYKES has for many years been associated with the Desert Laboratory of the Carnegie Institution, Tucson, Arizona. He has intimate knowledge of the arid southwestern United States in both physical and historical phases, and he has made comparative studies in the Libyan Desert (*Bull. Amer. Geogr. Soc.*, Vol. 44, 1912). His studies in historical cartography include the papers "The Mythical Straits of Anian" and "The Isles of California" in the *Bulletin of the American Geographical Society* (Vol. 47, 1915). To the *Geographical Review* he contributed "The Delta and Estuary of the Colorado River" (Vol. 16, 1926).

MLLE. CHOVEAUX, whose untimely death occurred on July 3, 1926, is described by Professor Brunhes as one of his most brilliant pupils. She had been acting as assistant in the Institut de Géographie at the Sorbonne and had already written several scholarly papers, including "L'influence des engrais Marins sur les rives du golfe du Morbihan" and "La Forest of Dean," which were published in the *Annales de Géographie* in 1920 and 1922 respectively. She took part in the International Geographical Congress at Cairo in 1925, from whence she visited Palestine collecting data for the article here published.

MRS. JOLLIE has traveled extensively and for long has had affiliations in Southern Rhodesia. She was Honorary Secretary and Organizer of the Responsible Government Party in S. Rhodesia, 1920, and is a member of the Legislative Council of Southern Rhodesia, the first woman to be elected to any British Colonial Legislature. Her writings include "The Real Rhodesia" (1924).

PROFESSOR HERMANNSSON, a native of Iceland, is Curator of the Fiske Icelandic Collection, Professor of Scandinavian Languages and Literatures in Cornell University, and author of numerous works on Icelandic literature.

COMMANDER PATTON is Chief of the Division of Charts of the U. S. Coast and Geodetic Survey. He is the author of "Yakutat Bay to Arctic Ocean" (*U. S. Coast Pilot, Alaska*, 1916) and "California, Oregon and Washington" (*U. S. Coast Pilot, Pacific Ocean*, 1917). He is Chairman of the National Research Council Committee on Shoreline Investigations and Secretary of the Executive Committee for study of coast erosion and protection appointed at the Asbury Park meeting (see Professor Johnson's paper in this number of the *Review*).

PROFESSOR JOHNSON is professor of physiography in Columbia University. In addition to numerous physiographic papers he has written "Shore Processes and Shoreline Development" (1919) and "The New England-Acadian Shoreline" (1925). He has made a special study of the influence of physiography in the conduct of military operations. "Topography and Strategy" was published in 1917 and "Battlefields of the World War" in 1921 as No. 3 of the American Geographical Society's Research Series.

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Map of Hispanic America, 1:1,000,000 [15.78 miles to 1 inch], Provisional Edition, Sheet South E–19, LA PAZ, 1922. Sheet South C–19, ACRE, 1924. Sheet North G–12, BAJA CALIFORNIA-SUR, 1924. $2.00 each sheet.

Map of Hispanic America, 1:6,000,000 [about 100 miles to 1 inch], compiled from nearly 250 sources and showing railways, drainage, international and administrative boundaries, and towns in graded sequence down to those with a population of 4000. Produced in black in three sheets—measurements of 2 (to border) are 34 x 28 inches, and of the third 32¼ x 30 inches. 1922. $5.00.

Mapa de la Republica de Panama, 1:500,000 [7.89 miles to 1 inch] compiled from over 100 original surveys, many of them unpublished. Printed in five colors. Shows drainage, relief by contours, cities and towns graded according to population and administrative importance, railways classified according to gauge, motor roads, wagon roads, and trails. Follows in general the scheme of the International Map of the World on the Millionth Scale, but hypsometric tints have been omitted and the provinces shown in color instead. Spanish throughout, including title and legend. Accepted as official map by the government of Panama. 33 x 63 inches. 1926. $3.00.

Separate Maps published in the *Geographical Review* and the *Bulletin of the American Geographical Society*, the majority in color. 25 cents each. A list will be sent upon request.

THE
GEOGRAPHICAL REVIEW

VOL. XVII JANUARY, 1927 NO. 1

THE FIRST GREENLAND EXPEDITION OF THE UNIVERSITY OF MICHIGAN

William Herbert Hobbs
University of Michigan

[With Figs. 20, 21, and 22 on Pl. I facing p. 14]

THE First Greenland Expedition of the University of Michigan returned in late September after a successful season's work in the field. The expedition was of a reconnaissance nature, preliminary to the larger effort planned for 1927.[1] The journey both to and from Greenland was made on the *Morrissey*, chartered by Mr. George Palmer Putnam, the Director of the Greenland Expedition of the American Museum of Natural History, and with Captain Robert A. Bartlett as skipper. The *Morrissey* sailed from North Sydney, Nova Scotia, on June 27 and arrived in Holstensborg on July 6. On the return she left Holstensborg on September 7 and reached North Sydney September 23.

Holstensborg numbers some two hundred souls including two European families, those of the Danish officials. The little settlement is situated upon a series of coastal terraces cut in the hard crystalline rock on the borders of a natural landlocked harbor which is one of the best in Greenland (Fig. 2). It is quite hidden from the sea but may be found from the location of the high Kaerlingerhaetten (2470 feet), which lies immediately north and is so named from its supposed resemblance to the peculiar topknot which is commonly worn by the old women in Greenland. This mountain appears in the background of Figure 22.

As was pointed out by Nordenskjöld, this district of Greenland enjoys a more favorable climate than its neighbors and is

[1] W. H. Hobbs: The University of Michigan Greenland Expedition of 1926–1927. *Geogr. Rev.*, Vol. 16, 1926, pp. 256–263.

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unusually dry and warm with clear skies.[2] It is also favored above its sister settlements by the importance of the halibut and cod banks in its vicinity. These fishing grounds have long attracted vessels from various other nations as well as from Denmark, but in 1924 a new local industry was developed at Holstensborg—a cannery for halibut and cod equipped with modern machinery.

FIG. 1—The members of the University of Michigan Greenland Expedition en route to Greenland on the schooner *Morrissey*, Captain Robert A. Bartlett, Master. Left to right in front row: Fergusson, Bartlett, Hobbs, Church; back row: Belknap, Gould, Oscanyan. (Photograph by H. C. Raven.)

SELECTION OF DISTRICT AND MAIN BASE

The area chosen for exploration by the Michigan Expedition lies within the widest part of the coast-land ribbon which surrounds the inland ice of Greenland. The district of Holstensborg includes a large hinterland representing a greater blank upon the Danish official map than is elsewhere to be found upon the west coast (Fig. 2). The inland ice, which it was our purpose to study, is within this district more remote and difficult of access than elsewhere; but it was believed that once it had been reached access to the interior would be found to be on easier grades than is usual. There was also a compensating advantage in that the district offered the opportunity as nowhere else to study the nature of the past glaciation. In most places the coast-land ribbon is so narrow that slight advances from the present ice front would completely cover the now exposed land areas.

[2] Otto Nordenskjöld: Nord- und Südpolarländer, Leipzig, 1926, p. 14.

On reaching Holstensborg the *Morrissey* took on board a local pilot and proceeded by way of Ikertôk Fjord to the entrance to Maligiak Fjord, the head of navigation for such vessels. Near by on the east side of the fiord is a great amphitheater (see Fig. 3) rimmed by steep

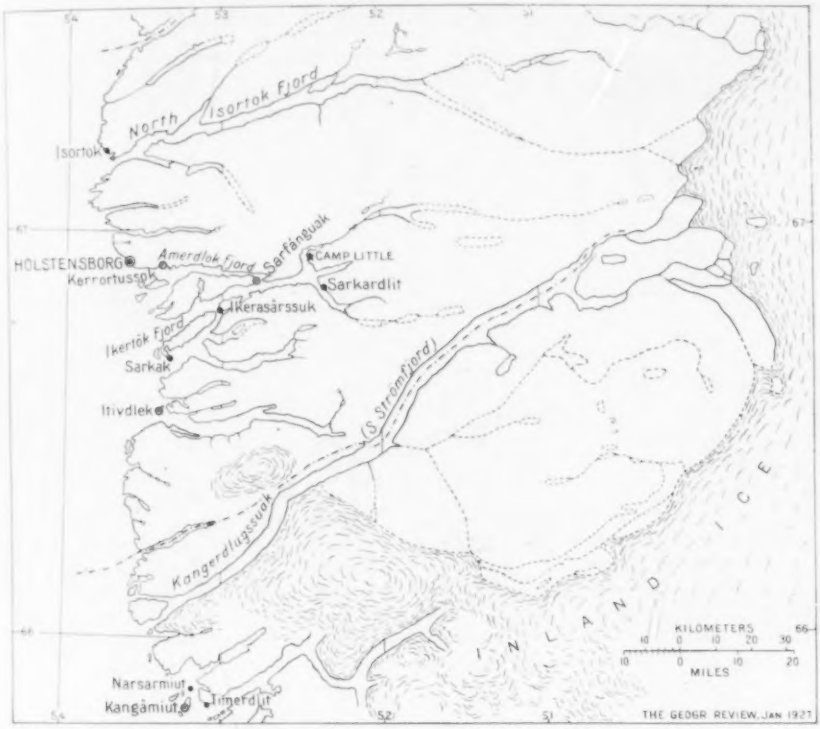

FIG. 2—Sketch map of the Holstensborg district from the official Danish maps. Scale approximately 1:2,000,000.

cliffs having an average height of about 1500 feet (Fig. 20). After a reconnaissance by motor boat to the head of the fiord it was decided to establish the main base of the Expedition within the amphitheater, which offered a good landing place and was supplied with an excellent stream of water, always difficult to find along the fiords of the district. The bay within the amphitheater we have named University Bay, and the peaks above the rim have been given the names of the past presidents of the University of Michigan. The camp itself is named after President Little.

PERSONNEL AND EQUIPMENT

The personnel of the 1926 Expedition consisted of six members, whose attention was to be given especially to meteorological and glaciological studies, though surveying of the routes and preparation of

maps were also in contemplation, as were also geological studies of a special character.

In addition to the writer as director, who was to make a study of glacial conditions and in a broad way of the meteorological problems, the party consisted of Professor Laurence M. Gould of the geology department at the University of Michigan, who acted as

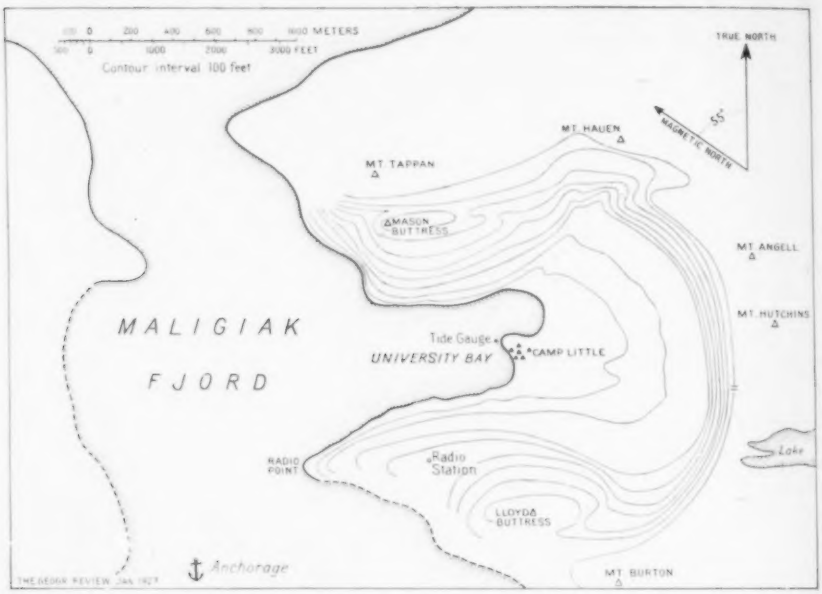

FIG. 3—The vicinity of Camp Little mapped by R. L. Belknap. [For Mt. Hauen read Mt. Haven.]

assistant director, geologist, and photographer; Mr. S. P. Fergusson of the United States Weather Bureau, upper-air expert and meteorologist; Professor J. E. Church, Jr., of the University of Nevada, meteorologist; Mr. Ralph L. Belknap, instructor in geology at the University of Michigan, surveyor and geologist; and Mr. P. C. Oscanyan, Jr., radio expert and a valuable assistant to Mr. Fergusson.

Dr. C. F. Marvin, Chief of the United States Weather Bureau, in addition to loaning the Expedition the services of Mr. Fergusson, either furnished or loaned the greater part of the meteorological equipment, including three of the new Fergusson meteorographs and one hundred and fifty pilot balloons. Dr. C. G. Rossby kindly furnished three of his new deflating devices for sounding balloons, which were of the greatest service in our upper-air studies. Colonel Lester C. Jones, Superintendent of the United States Coast and Geodetic Survey, loaned a new ten-second transit and a standard tide gauge. Professor Clarence E. Johnston loaned us from the equipment of the surveying department at the University of Michigan a thirty-second transit. The wireless installation was designed by Mr. John L. Rein-

artz, the well-known short-wave radio expert; and it was through his influence that we secured the services of Mr. P. C. Oscanyan, Jr., our radio operator. The batteries for our wireless station were contributed by the Burgess Battery Company of Madison, Wisconsin, the condensers were presented by the Allen D. Cardwell Company, the meters by the Jewell Electrical Instrument Company, a wave meter by the General Radio Company, storage batteries by the Exide Battery Company, and insulators by the Corning Glass Company. The

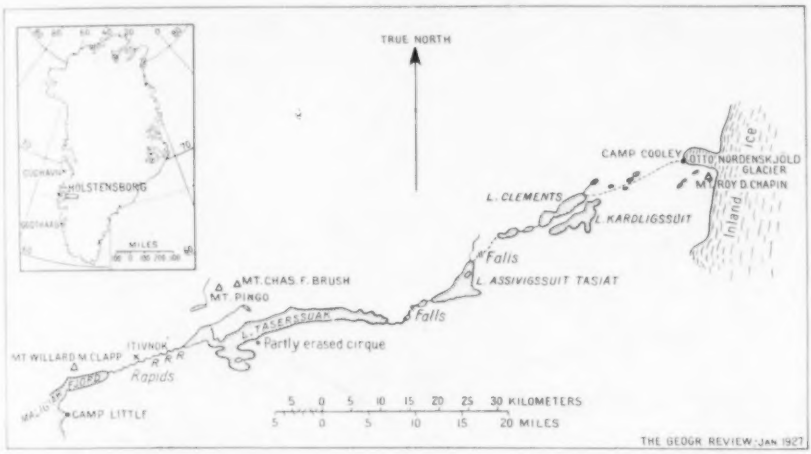

FIG. 4—The route to the inland ice from Camp Little mapped by R. L. Belknap. The larger lake between L. Clements and L. Assivigssuit is L. Offield. The inset shows the general situation of the area of the Expedition's explorations.

State of Nevada Snow Surveys generously loaned the Expedition a valuable circut photographic camera with a Zeiss Protar lens.

THE JOURNEY TO THE INLAND ICE

A party consisting of Hobbs, Gould, Church, and Belknap with four Greenlanders (half-breed Eskimos) set out on July 26 to cross the tundra to the inland ice with the intention of advancing over it for a period of eight to ten days. In many respects the late spring season is best suited for exploration in Greenland, because at this time the lakes are still frozen, and the ground buried in snow facilitates dog-sled travel. The summer season, to which the Expedition was limited by the regular duties of its personnel, is less favorable: advance across the tundra surface is necessarily slow, and the pest of insects is an almost continual torment.

The first section of the journey was made by umiak (Fig. 10), the large Greenland skin boat used primarily by the women, though we were towed to near the head of Maligiak Fjord by the Danish government sloop in charge of the manager at Sarfanguak settlement. By

FIG. 5

FIG. 6

FIG. 7

FIG. 5—The first short-wave wireless station (see Fig. 3) to be erected away from the coast in Greenland: mast at extreme left. The station is at an elevation of 400 feet above Camp Little. In the distance at the right Mt. Willard M. Clapp. View taken in late August after the first snows had fallen in the higher levels. Maligiak Fjord is hidden just beyond the immediate foreground. (Photograph by L. M. Gould.)

FIG. 6—The ice-cap party en route to the interior; marching over the tundra after umiak and canoe have been left behind. (Photograph by L. M. Gould.)

FIG. 7—Subdued hilly topography within the hinterland belt. View of Lake Offield from the camp site at the southwest shore. (Photograph by L. M. Gould.)

FIG. 8

FIG. 9

FIG. 10

FIG. 8—Looking northward across Lake Taserssuak from near its southwestern corner. Near the center is the Pingo, the highest point in the district; to the east Mt. Charles F. Brush. The foreground shows the effect of a second advance of the ice front, the distant ridge the flatly convex contours wrought by ice-cap extension at a high level. (Photograph by L. M. Gould.)

FIG. 9—The site of Nordenskjöld's camp at the northeast corner of the northwestern arm of Lake Taserssuak. Note the series of terraces cut through by a canyon. (Photograph by L. M. Gould.)

FIG. 10—Looking northwest from the south shore of Lake Taserssuak. On the horizon the convexly rounded contours of the Pingo and at its right Mt. Charles F. Brush. In the middle distance the strongly developed east-west strike of the gneiss. In the foreground the subdued contours of the hinterland, and the party's umiak, canoe, and kayak. (Photograph by L. M. Gould.)

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unloading our cargo and portaging past the rapids of the river at Itivnok and poling and roping through the higher rapids, we were able to continue by umiak as far as the eastern end of Lake Taserssuak (Fig. 10), as Nordenskjöld had done in 1909.

The umiak was cached at the head of Lake Taserssuak, where a depot of provisions was left. We then proceeded on foot carrying heavy packs and an 18-foot Chestnut canoe weighing 75 pounds. The wisdom of taking with us the canoe was later manifest, for by portaging it a distance of 16 miles in all we spared ourselves packing more than 500 pounds a total distance of 75 miles (including relays) over moderately difficult terrain. Beyond Lake Clements, where the canoe was cached, we carried all our supplies, which included equipment for the 1927 expedition, upon our backs.

Arrangements made with the Greenlanders of the party required them to find their own provisions. Each brought with him an antiquated type of rifle, evidently expecting to depend in part upon game for food. The interior regions, however, proved almost devoid of any sort of game, if we except the flocks of wild geese that were generally too shy to approach near enough for a successful shot. Farther out towards the coast, ducks and ptarmigan (protected in the summer) were common, as was also the white arctic hare. In the far interior we found one fresh track only of caribou. On the other hand we came repeatedly upon ancient antlers of caribou half buried in the tundra, a fact which gives support to the suggestion made by the manager of the canning factory that a reindeer industry be inaugurated in the country. Hardly had we reached the margin of the inland ice —on the tenth day out from Camp Little—when the head Greenlander reported that his supply of food was exhausted. As we were now forced to feed from our own supplies eight men instead of four, it was necessary to reduce our stay on and near the inland ice to a period of four days and return by forced marches on reduced rations.

The Surface of the Inland Ice Near Its Margin

We first established contact with the inland ice on the outlet tongue which lies northeast of Camp Little about 65 miles as the crow flies and about 75 miles along the course traveled by us. This outlet was visited by Nordenskjöld in 1909, and it is with great pleasure that we have given it the name Otto Nordenskjöld Glacier (Figs. 11 and 12). It had been the expectation that after making the trek across the broad Holstensborg hinterland we should find the inland ice rising on flatter grades than is elsewhere generally the case, and in this we were not disappointed (Fig. 12). Camp Cooley on the southern margin of the outlet, near its front, is at an elevation as determined by aneroid of nearly a thousand feet, but this may be far from correct.

FIG. 11

FIG. 12

FIG. 11—The front of the Otto Nordenskjöld glacial outlet from the inland ice. Before it in the valley the apron with its braided stream over a deep deposit of gray rock flour. This is so soaked with water as to make an impassable quagmire. Drying of its upper surface produces a powder-like loess, which is raised in clouds by the wind and spread over the tundra. The site of Camp Cooley is hidden behind the most distant ridge at the right of the picture. (Photograph by L. M. Gould.)

FIG. 12—View from Camp Cooley across the surface of the Otto Nordenskjöld Glacier. The crevassed surface makes the glacier almost impassable. (Photograph by L. M. Gould.)

Within the Nordenskjöld Glacier tongue there is sufficient forward movement to produce a quite rough and difficultly passable surface with seracs separated by canyons in which during the first week of August streams of water were in many places too wide to jump across. Some further detail of the surface topography farther in is to be seen in Figure 29. The glacier surface was without any covering of snow whatever, but near the lateral margins it was veneered thinly with gravelly materials which often encrusted cones and hillocks of ice from ten to fifteen feet in height. Midway of the southern margin of this glacier lies a beautiful ice-dammed lake perhaps a half mile across backed by vertical cliffs of ice within which the ice structure is clearly revealed. This lake I have named Lake Laurence M. Gould.

Glaciological Results

Existing Glaciers of Mountain and Ice-Cap Types

In order to interpret properly those of our observations that relate to past glaciation within the coast-land ribbon, it is essential to give close attention to those processes by which the existing Greenland glaciers are modifying the rock surface beneath and about their borders. Contrary to some prevalent beliefs based wholly upon the past glaciations in North America and in Europe within moderate latitudes and on surfaces of low relief, glaciation outside the main interior mass of the Greenland inland ice presents a varied aspect.

As was pointed out in 1910[3] the inland ice of Greenland sends out from its margins tongues of two quite different types, (1) those which make their way down valleys to low levels and which therefore are joined to the inland ice by an ice amphitheater with fractured walls (Fig. 24) and (2) those which push their way out upon plateaus at high levels and make junction with the inland ice without noteworthy changes in grade and on generally smooth surfaces (Fig. 24). The former modify the rock terrane by erosion chiefly, causing a deepening of the rock trench within which they lie and a widening of it by sapping the side walls so as to produce U valleys and their extensions in fiords.

The high-level tongues, on the contrary, since they have no rock above them, in general merely degrade the underlying rock and progressively plane off the existing irregularities of its surface so as to yield flatly rounded contours convex upward. At the front of these high tongues where the ice becomes thinned, in the event that there are irregularities of the rock terrane, frost weathering by alternating thaw and freeze yields the peculiar features resulting from weathering in such altitudes wherever glacial ice is present. We find sharply

[3] W. H. Hobbs: Characteristics of the Inland Ice of the Arctic Regions, *Proc. Amer. Philos. Soc.*, Vol. 49, 1910, pp. 57–129; reference on pp. 81–84.

FIG. 13

FIG. 14

FIG. 15

FIG. 13—Looking southward across Ikertôk Fjord. The dark shadows on the glacier are the walls of cirques over which the inland ice sometimes cataracts. To the east (left) the glacier covers all the land as a carapace and as such is joined to the inland ice. (Photograph by L. M. Gould.)

FIG. 14—Looking southwest from above Nordenskjöld's camp on the northwestern arm of Lake Taserssuak. At the left the relatively smooth contours shaped by the later advance of the ice front: at the right beyond the nearest headland a partly submerged cirque resulting from mountain glaciation at the front of a high outlier from the inland ice. (Photograph by J. E. Church, Jr.)

FIG. 15—A cirque on the south shore of Lake Taserssuak formed by mountain glaciers during a retreat of the ice front but largely erased by erosion beneath the ice during a later readvance. The walls polished by glacial erosion: elevation of floor about 700 feet. (Photograph by L. M. Gould.)

FIG. 16

FIG. 17

FIG. 16—University Bay on the eastern side of Maligiak Fjord as seen from a pass in the cirque rim at an elevation of about 900 feet. The view looks westward, and Camp Little is near the center of the nearer shore (see also Figure 20, which looks into the Bay from across the fiord). (Photograph by W. H. Hobbs.)

FIG. 17—Looking southward across the upper part of Maligiak Fjord (faintly seen in left middle distance) at the high country, which has been glaciated by a single advance of the ice front. Beyond the visible part of the fiord are seen two of the great fault escarpments of the block pattern. (Photograph by W. H. Hobbs.)

FIG. 18

FIG. 19

FIG. 18—Looking northwestward from a high point north of Maligiak Fjord and showing the numerous lakes on the high plateau with their noteworthy rectangular outlines determined by the fracture pattern within the rock beneath. In the right middle distance fault escarpments, and in the distance an isolated ice cap with marginal tongues. (Photograph by W. H. Hobbs.)

FIG. 19—The characteristic high plateau country of the Holstensborg district with its numerous glacial lakes in rock basins. The latter betray by their outlines the fracture pattern. (Photograph by L. M. Gould.)

accented surfaces that are concave upward and are characteristic of the fretted upland—cirques, cols, comb ridges, etc.[4] The degree of accent in the relief is dependent on the time the action continues, but frost weathering is one of the most rapid of all degrading processes. The fretted upland which is developed under these conditions differs from that formed by the true mountain glaciers of lower latitudes in that, in its pre-mature stage of grooved upland, the rock surface above the cirques is covered with a carapace of glacial ice and is planed and polished by its action. This high-level glacier often cataracts into the cirques below, where the ice may even be rejuvenated into a new glacier born within the cirque.

Nordenskjöld with keen insight established the fact of these conditions when he studied the margin of the Greenland inland ice on Scoresby Sound and other localities of east Greenland in 1899, and later, in 1909, in a study of the long arm of the inland ice that pushes out nearly to the sea south of the Kangerdlugssuak (southern Stromfjord)[5].

Whenever a high tongue from the inland ice undergoes an advance, and much the same may be true for isolated bodies of carapace glacier, erosion beneath the advancing carapace erases the pinnacles of the fretted upland at its front and at the same time progressively shallows the basins of the cirques. In a map of James Ross Island in West Antarctica Nordenskjöld has represented a carapace above such shallowed cirques into which in one instance—the Hobbs Glacier—it discharges a cataract of glacier ice.[6]

The surface of the rock above such shallowed cirques when laid bare will be found to be planed, polished, and striated; in which respect it is in striking contrast, though similar in form, to the premature grooved upland such as is to be found in the Uintah and Big Horn Mountains. Classical examples from past glaciation by continental glaciers are to be found in northern Norway, where the partly erased cirques have been described as *kjedels*. It is worth noting that Nordenskjöld has compared the region surrounding the inland ice of Greenland to that of Norway with its former and its present existing ice caps.

Evidences of Former Glaciation by Inland Ice

Without study of the action which goes on in high levels at the front of the inland ice as given in the preceding section, no intelligent

[4] W. H. Hobbs: Earth Features and Their Meaning, New York, 1912, pp. 367–382.

[5] Otto Nordenskjöld: On the Geology and Physical Geography of East-Greenland, *Meddelelser om Grønland*, Vol. 28, 1907, pp. 151–284; reference on p. 261. Also *idem:* Einige Züge der physischen Geographie und der Entwickelungsgeschichte Süd-Grönlands, *Geogr. Zeitschr.*, Vol. 20, 1914, pp. 425–441; 505–524; 628–641; reference on pp. 430–432.

[6] Otto Nordenskjöld: Die Schwedische Südpolar-Expedition und ihre geographische Tätigkeit (Wissenschaftl. Ergebnisse der schwed. Südpolar-Expedition 1901–1903, Vol. 1, Part I), Stockholm, 1911. See also W. H. Hobbs: Studies of the Cycle of Glaciation, *Journ. of Geol.*, Vol. 29, 1921, pp. 370–386; reference on pp. 382–386.

FIG. 20

FIG. 21

FIG. 22

FIG. 20—Maligiak Fjord looking east. Of the cirques which have been drowned through partial postglacial submergence of the district, the central one in the picture encloses University Bay and Camp Little. Later uplifts are recorded in the terraces which are in part cut in the glacial clays and in part in the crystalline rock, the latter seen especially well in the left middle distance. The headland at the right of University Bay is Radio Point. Back of it rises Lloyd Buttress, and above it Mt. Burton. In the left middle distance is the head of Maligiak Fjord, and beyond it the meandering Itivnok River, along which is the route to the inland ice. At the extreme left on the horizon is the Pingo, and beyond it at the right Mt. Charles F. Brush, both of them in part covered by the snows of late August. (Photograph by L. M. Gould.)

FIG. 21—Panoramic view from the summit of the Pingo looking south. It shows the generally accordant summit levels of the higher ridges and the numerous lakes. (Photograph by L. M. Gould.)

FIG. 22—The inner harbor and the settlement of Holstensborg. In the distance in the right center the striking Kaerlingerhaetten (old woman's topknot) which may be seen from far out at sea. Throughout, but particularly within the settlement, the uplifted strands carved in rock are well shown. The new church is built upon a pedestal-like top and represents one of the higher shore lines. The large building in the foreground is the new cannery. (Photograph by L. M. Gould.)

inquiry into past glaciation can be carried out. It is further necessary to have regard at all times to the profound changes in level, and particularly the subsidences, which have gone on since the glaciation, if trustworthy conclusions are to be drawn. The resemblance in this latter respect to the peninsula of Norway is a vital one. It is, moreover, exactly the study of the earlier cirques and the fact that they develop only on relatively high plateaus, that permits us to judge from their present position the extent of the subsidence which has characterized the land block within which they are found.

So far as my observations have gone, the entire exposed area of land within the Holstensborg District has at one time been covered by inland ice. The vicinity of the settlement of Holstensborg itself shows the characteristic rock contours and the other indications of glaciation beneath inland ice (Fig. 22), except where these have been planed away by marine erosion and lifted to their present position.

The High Coastal Belt and the Low Belt of the Hinterland

Nordenskjöld in his monograph so often cited here has emphasized the contrast between the rugged belt of country near the coast and the hilly region at lower levels lying behind it. On his sketch map[7] the coastal region is described as "normal mountain region with prevailingly rounded features" and the inner low region as "hilly land." This contrast we have confirmed, but the matter is not altogether simple. Examples of the topography of the coastal belt, though not that in immediate vicinity of the main coast, are represented in Figures 17, 18, 19, 20, 21, and 23; that of the low hinterland in Figure 8 (foreground) and in Figure 15. At the right in Figure 14 is shown the coastal type of topography, and to the left a small area of the smoother interior region.

In contrast to the near coastal area about Camp Little, which has an average altitude exclusive of the fiords of perhaps 1300 feet, the hinterland has an average elevation of probably two-thirds that amount. Though within both of these areas the higher surfaces particularly show convexly rounded contours, within the outer district there is a noteworthy ribbed pattern due to the dominant east-and-west strike of the crystalline rock—a sort of glorified *roches moutonnées* topography. Within the interior district this ribbed structure has largely disappeared through increased glacial denudation. Within both belts the large erratics are chiefly restricted to the tops of the higher ridges, and in both also they are much weathered,[8] but within the exterior belt one practically never finds erratics which re-

[7] Nordenskjöld, Einige Züge der physischen Geographie, p. 427, Fig. 1.
[8] *Ibid.*, pp. 514–515.

veal distinct glacial faceting or striation. In the hinterland belt, by contrast, faceted and striated boulders are not uncommon.

The surface of the rock pavement within the interior region is well polished even where not protected by deposits. Where it has such protection by glacial clay the marks of glaciation are remarkably well preserved (Fig. 25). For the outer belt, except along the fiords, such polished pavement is seldom found.

In further contrast to the exterior belt the inner one has its surface plastered with a thick deposit of gray glacial clays, and this ve-

FIG. 23—Looking southward across Maligiak Fjord and showing two of the great fault escarpments which outline the block pattern of the relief. These have generally determined the position of the imperfectly rectangular cirques now in part submerged. Near the shore are seen terraces from uplifted strands. (Photograph by L. M. Gould.)

neer extends to the summits of the highest ridges. Such clays show in much perfection the operation of the subarctic process of solifluction, the pattern on flat surfaces being the hexagonal mosaic and on slopes a down-slope ribbed structure often divided by cross fractures into elongated rectangular segments. Owing to the dryness of the summer season the clay is usually hard and sometimes almost stony. Connected with this solifluction is the process of nivation, and the embryonic niches[9] show many stages.

The above described characteristics of the hinterland belt apply especially to the route followed by us to the inland ice, where our course was for much of the way along shallow trench-like valleys more or less connected. A high east-west ridge to the north of Lake Tasersuak is characterized by smoothly rounded knob-like projections and extends eastward far into the interior and westward to about the longitude of the head of Maligiak Fjord. This ridge supports the great dome of the Pingo (4350 feet) and the elongated one of Mt. Charles F. Brush, as well as many others; it is believed to have been shaped beneath a high-level tongue which pushed out from the inland ice

[9] Hobbs, Characteristics of Existing Glaciers, p. 21, Fig. 8.

in much the same way as did that now existing south of the southern Stromfjord (Fig. 2).

The checkerboard pattern of the surface topography prevails throughout the Holstensborg district and is due to the fault pattern within the underlying terrane (see below, p. 34). In the exterior belt this pattern is accentuated by escarpments whose height is many hundreds of feet (Fig. 23). By contrast, within the inner belt, as, for example, across the broad valley to the southward from the prominent waterfall below Lake Assivigssuit Tasiat (see Fig. 4), the lines of this

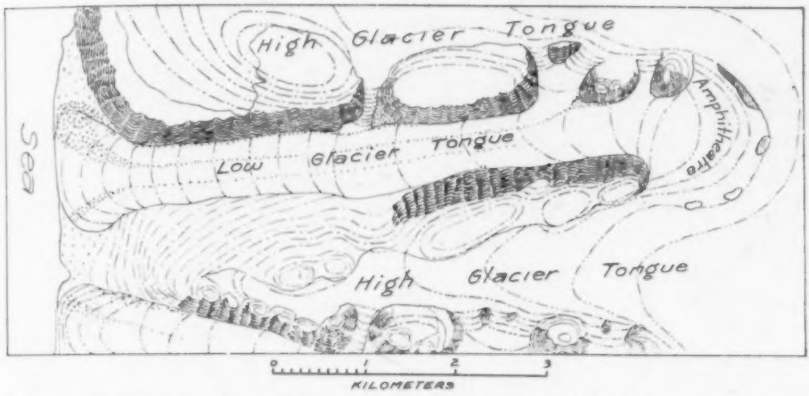

FIG. 24—Map of the area east of Umanak Fjord to show the characteristics of a low tongue (outlet) from the inland ice and also a high one from the same mass. (After von Drygalski.)

pattern can be followed with the eye for many miles although the irregularities have now been largely planed down. Particularly within the outer belt the abundant lakes upon the plateau are remarkably irregular of outline and present rectangular elements which bring out strikingly the checkerboard pattern (Fig. 18).

At about the same time that the high-level tongue of ice covered the higher ridge north of Lake Taserssuak a long low-level outlet tongue extended down the great trench formed by the northwestern arm of the Taserssuak and its extension in the present flood plain of the Itivnok River and Maligiak Fjord. Along this valley, particularly at the lower levels which are still exposed above tide, the glaciation of the rock surface is perfectly preserved. This tongue of ice through blocking drainage lines has left behind a large series of lake terraces. The parallel high-level and low-level ice tongues here described recall by their position the similar ones now existing at the head of the Umanak Fjord (Fig. 24).

READVANCE OF THE GREENLAND INLAND-ICE FRONT

Our interpretation of the above evidence is that after an earlier advance of the continental glacier, which extended at least to the

present coast, there was a retreat of this front followed by the formation of cirques along the margins of the higher ridges (see above, p. 14 and Fig. 13). A later readvance of the front as far as the western end of the southern arm of Lake Taserssuak brought about the much greater degradation within the hinterland. At the same time a long arm pushed its way out at a higher level upon the ridge supporting the Pingo.

The moraines throughout the Holstensborg district, in so far as they have form, are largely those left behind by the low-level tongues of ice, and these are usually of the terminal or lateral types. They are especially well formed within the valley below Lake Offield. A very heavy one, also, with a curiously concave front no doubt indicating a late stage, is found at an elevation of about 1575 feet to the northward of Maligiak Fjord near its head. The front of the ice when it was without extended tongues seems to have produced no depositional features whatever, though heavy deposits of rock flour remain within the fiords, and much has clearly been removed, as is shown by the steps of the elevated strands cut in them (Fig. 20).

Farther in toward the margin of the inland ice the trenched character of the topography, so noticeable farther out, becomes subdued. We encounter a type of surface which is more nearly within one plane and above which rise peculiar knob-like hills in great numbers (Fig. 7). This surface was shaped, it was believed, not beneath tongues of ice of either type but beneath the broad mass of the ice dome itself. With much probability a surface of this general character forms the basement of the marginal portions of the inland ice today.

Cirques of the Twice Glaciated Hinterland Belt

Perhaps the most convincing evidence for a later readvance of the inland ice is supplied by the partly erased cirques. On the northern face of the ridge that rises south of Lake Taserssuak (Fig. 15) the floor of a cirque of this type is now about 700 feet above the sea, and the surrounding rock surface is planed and smoothed.

As is well known, it is the floor alone of cirques that has been shaped directly by glacial erosion. The surrounding walls have been given their form by the process of sapping, and they present surfaces formed by separation of the rock generally along joint planes. Here, however, the walls of the partially erased cirque testify to the readvance of the ice front by their well polished surfaces glistening in the sun (Fig. 15). One other example of a largely erased cirque is found in the valley below Lake Offield with its floor at an elevation above 400 feet.

Greenland cirques, as has been already pointed out, are features shaped at relatively high levels in connection with the plateau extension of the inland ice. According to Nordenskjöld the upper

FIG. 25

FIG. 26

FIG. 25—Looking west from the south shore of Lake Taserssuak. In the foreground is seen the perfect polish and striation of the crystalline rock wherever this has been overridden by the second advance of the ice front. (Photograph by L. M. Gould.)

FIG. 26—One of the rectilinear canyons formed on a displacement and here about 50 feet deep. Below the margin of the picture in the foreground this canyon turns sharply to the right to form an almost perfect right angle. The locality is across Maligiak Fjord from Camp Little in a northwesterly direction. (Photograph by L. M. Gould.)

levels of these cirques on the margin of the ice tongue south of the Holstensborg district lie above 3000 feet of altitude. We have as yet no data concerning the level of their floors, but these are probably well above 2000 feet. Throughout what appears to have acted as a great composite earth block extending from the Maligiak Fjord to Taserssuak, the cirques are near to or at present sea level (Figs. 14 and 20). It is difficult to explain these observed conditions in any other way than as due to subsidence amounting in the aggregate to at least from 1000 to 2000 feet. It is this postglacial subsidence that is responsible for the fiord system, probably the most remarkable in the world.

In the block represented by the main body of Lake Taserssuak, although the general level of the land is lower than in the exterior belt (at least along the route we followed) the partly erased cirque above described has its floor now at an elevation of about 700 feet. Below Lake Offield a second partly erased cirque has its base at an elevation of over 400 feet—both elevations as determined by aneroid. It would appear, therefore, that the subsidences of the larger land blocks within the Holstensborg district have been greatest in the block that includes Camp Little and notably less in the next block toward the interior, that which includes Lake Taserssuak. This is what we should expect, both from the depths of the fiords and as a progressive subsidence of the high interior outward toward the sea. This has special interest in connection with past glaciations, since it shows that the excess of glacial denudation within the hinterland belt over that of its immediate foreland has been even greater than is represented by the differences of average summit levels today.

Meteorological Results

Systematic Meteorological Observations at Camp Little

A few days after our arrival at the base camp two standard Weather Bureau barographs and two Weather Bureau thermohygrographs had been tested, set up, and were recording within a shelter of the French pattern. At about the same time cloud observations were begun and were continued by Mr. Fergusson at regular intervals until camp was broken on September 3.

Although a standard anemometer was taken and set up at Camp Little, it was soon found that the winds observed at such low levels, where the topography is of the west Greenland type, tell us little except the directions of the sluiceways within which they blow. To Greenlanders it is a well known fact that the wind blows lengthwise of the fiords, so that it is futile to seek shelter from a strong wind by doubling a headland in the fiord. At Camp Little the wind also reverses direction with remarkable suddenness.

Of immediate results at Camp Little Mr. Fergusson reports the most striking to be the unusually low wind velocities, the great height of the lower clouds, the large ranges of temperature and their sudden changes, the low atmospheric pressure which never at any time exceeded 1012 millibars (29 inches), and the extremely low precipitation.

As regards these conclusions, it should perhaps be pointed out that the present summer season in western Greenland was abnormal in having fine clear weather. Probably no one living is more competent to give an opinion upon this subject than Dr. Knud Rasmussen, since he has spent his lifetime in Greenland, and he told the writer that never had he known so fine a summer season.

Mr. Fergusson reports:

> The most conspicuous meteorological phenomena of the summer are the very small precipitation (only about 16 millimeters occurring during the 9 weeks), a high average cloudiness, low atmospheric pressure, and—perhaps most noteworthy of all—the very slow movement of the wind at all heights, determined from observations of clouds and balloons. The heights of the clouds below the alto-stratus appear to be decidedly greater than those of the same clouds in lower latitudes, even during periods of storm lasting several days. At the surface of the ground and particularly near the large fiords the familiar diurnal phenomena of sea and land breezes, intensified at times by the air coming from the inland ice cap, are very marked, the velocity of the air probably occasionally exceeding ten meters a second. These surface winds, as is the case elsewhere, do not extend very high (seldom more than 100 meters and frequently only to half this height), and when a cyclone of more than ordinary intensity prevails the diurnal and local phenomena become insignificant.

Before we departed for Greenland several European meteorological services having stations not too remote from Greenland were requested to carry on regular observations of the directions of the higher clouds, particularly during the period of our stay in Greenland. It is with much pleasure that I report that cloud observations of this nature were made regularly by Dr. Thorkel Thorkelsen at Reykjavik, Iceland. Through the courtesy of Dr. Thorkelsen these observations will later be compared with those made by Mr. Fergusson at Camp Little.

Observations During the Journey to the Interior

Throughout the twenty-two day journey to the inland ice Professor Church with painstaking care carried out regular three-hourly observations both day and night with a standard psychrometer to determine air temperature and humidity for comparison later with the records of the thermohygrographs at Camp Little. Of them he reports as follows:

> The methods employed were typical of reconnaissance work. The Danish weather station at Holstensborg was used as a basis of comparison but with the addition of the balloon station at Camp Little as an intervening point. The records

at the former station represented readings taken daily at 8 a. m. and 2 and 9 p. m. Those at Camp Little were continuous traces of temperature, pressure, and humidity, while the readings on the inland trip were taken every three hours throughout the twenty-four hour period. A sling psychrometer, aneroid barometer, anemometer, and pocket compass made up the outfit. Except for four days at the inland ice, the party was practically in constant motion. However, the topography was not sufficiently diverse to prevent the combination of the daily readings into individual groups.

TABLE I—TEMPERATURE AND HUMIDITY, HOLSTENSBORG DISTRICT AND SIERRA NEVADA

Temperature (F.)	HOLSTENSBORG	CAMP LITTLE	INLAND	RENO
Mean	47.8°(*a*)	48.6°	49.2°	69.6°
Maximum	57.6°	69.0°	64.0°(*b*)	97.0°(*c*)
Minimum	39.7°	32.0°	31.0°	36.0°
Mean Range	9.6°(*d*)	17.8°	18.7°	34.6°
Humidity (per cent)				
Mean		70.6(*e*)	63.7	25.3
Mean, Maximum		86.9	78.9 (Taserssuak)	39.3
Mean, Minimum		52.4	44.7 (Edge inland ice)	16.3

a. Reduced from 49.4° on the basis of more numerous daily measurements at Camp Little.

b. Possibly lower than at Camp Little because of increase in elevation.

c. Maximum temperature on Mt. Rose (10,800 feet) near Reno 72.3°, or practically that in Greenland.

d. Uncorrected range 4.4°, caused by lack of minimum temperature in record. Minimum occurs approximately at 2 a. m.

e. This represents a correction of approximately 7 per cent for instrumental error. If applied throughout the entire series, the mean would have been 2 per cent higher still.

Because this district of Greenland has been described as semiarid rather than moist, comparison is further made with the hill country of Lake Tahoe and Reno on the eastern slope of the Sierra Nevada on the edge of the Great Basin. Individual but similar periods rather than normals are employed. The period for Greenland covers July 27–August 17, and for the Sierra Nevada August entire. The evaporation studies (see Table III), however, cover the period of August 18–September 2 after the return from the inland ice.

(1) *Temperature.* The disparity of 11.9° F. found by Nordenskjöld to exist between Holstensborg and Inner Greenland sinks to 1.4° F. under a longer comparison and more frequent readings. However, the temperature shows a steady though slight increase from the ocean to the inland ice. Length of record and lack of space compels the use of means and extremes in this and other tables.

On the basis of the mean of 48.4° F. for June–July, 1909, quoted by Nordenskjöld, the present season in Greenland could not have been abnormally warm. The only abnormal element must have been the lack of precipitation or wind, either of which would increase human comfort noticeably.

2. *Relative Humidity.* The relative humidity of the hinterland is only slightly less than at the head of the fiord. However, it is lowest at the edge of the inland ice, thus indicating a gradual decrease inward from the sea. Unfortunately, no humidity measurements at Holstensborg are available.

Steppe Climate of the Hinterland and Its Probable Cause

In describing[10] the "warm dry steppe region on the border of the inland ice" Professor Nordenskjöld brought out many interesting observations, such, for example, as the saline content of the rock-basin lakes, in support of his opinion. Our experience within the same region is confirmatory of his. On the entire twenty-two days of the journey to the inland ice we had only a few hundredths of an inch

Table II—Analysis of Water of Three Greenland Lakes
(*Percentages*)

	Ilivilik	Itivnok	Above Taserssuak*
SO_3	44.31	50.55	23.6
Cl	9.07	8.80	5.0
CO_2		0.85	
$Fe_2O_3 + Al_2O_3$		2.80	
MgO	3.48	2.98	5.8
CaO	3.21		16.5
Na_2O	28.19	33.02	23.3
K_2O	4.99	1.00	2.6
Silica (SiO_2)			4.0
Iron and Aluminum Oxides			16.4†

*Analysis by Wayne B. Adams, chemist of the Division of Food and Drugs Control of the University of Nevada, as a voluntary service to the Greenland Expedition.

† "Iron and aluminum content would probably be lower when the water was fresh and in its original state."

of precipitation; day after day there were clear skies with remarkable development of cirri in new and varied patterns which surpassed those observed in all our earlier experiences. At such times of clear weather we not infrequently saw showers over the summit of the Pingo and in the far western skies, though later reports showed that the weather at such times was uniformly good at Camp Little.

Of the numerous interior lakes the majority lie in rock basins, and, as very many of them are without outlets, it is hardly surprising that they are brackish. Only once, however, did we find a lake of which the water was so salty as to be unpalatable. A sample of this water from east of Lake Taserssuak was taken by Professor Church, who has had it analyzed to compare with samples collected by Nordenskjöld from Ilivilik and Itivnok as shown in Table II.

Though the season of 1926 was abnormal and though our temperature records reveal no such sharp contrasts as Nordenskjöld thought he had found between the remote hinterland and the coast district, it is not doubted that the Holstensborg district generally as compared with districts to the north or south enjoys a warmer and

[10] Nordenskjöld, Einige Züge der physischen Geographie, pp. 509–514.

drier climate. For this there is believed to be a good explanation in the peculiar position of the high ice tongue to the south of the southern Stromfjord, as may be seen by reference to the map, Figure 2. As is well known and as was long ago pointed out by Rink, the easterly winds blowing off the inland ice have the warm and dry characteristics of the föhn and are accompanied by clear skies, whereas the rains are brought by low pressure areas that move up Baffin Bay from the south. The one district from which these rain-bearing winds can be cut off by an ice tongue is the Holstensborg district. This ice tongue holds a unique position, for the only other ice tongue that pushes out to the sea on the west Greenland coast is the Frederikshaav Isblink far to the south, and since this takes a southwesterly direction it is no barrier to the progress of the rain-bringing "lows." A rather remarkable instance of excessive insolation such as is best observed in arid regions is illustrated in Figure 33.

Studies of Transpiration and Evaporation

To one not familiar with arctic conditions, the survival throughout the summer season of the stunted vegetation upon the small rainfall seems a marvel. It is, however, easily explained. At a depth of one to two feet below the surface of the tundra a solid mass of ice is encountered even in midsummer, and above this nonpermeable base the supply of moisture from the snow-melting period in the spring is conserved as though in a sponge. Professor Church reports:

> Quite in keeping with the low temperature of air and water and the relatively high humidity is the low rate of evaporation and transpiration, the former being approximately one inch as compared to more than seven inches at Lake Tahoe. Furthermore, the period represents one of the two warmest months in an apparently dry summer. Thus the enigma of light precipitation and vigorous growth becomes explicable. The experiment was conducted with Mt. Rose apparatus and by methods used in studying evaporation of snow. Owing to lack of space, only the summary in Table III is given.

The Greenland Glacial Anticyclone

The primary object of the University of Michigan's Greenland Expedition is study of the Greenland glacial anticyclone.[11] The continent of Greenland operates upon the earth's atmosphere as a great refrigerator, whereas the belt along the equator may by contrast be compared to a furance. It is in reality the differences in temperature of these areas—not the high temperature of the latter only—which, in so far as the northern hemisphere is concerned determine the vigor of the disturbances within the earth's atmosphere.

[11] W. H. Hobbs: The Glacial Anticyclones: The Poles of the Atmospheric Circulation, With an Introduction by Hugh Robert Mill (Univ. of Michigan Studies, Sci. Ser., Vol. 4). New York, 1926.

We are not here dealing with a mere theoretical conception but with an empirical law the basal observations for which were made by the late Admiral Peary when he discovered that winds above the inland ice of Greenland invariably blow in a general direction corresponding to that of the slope. This law of the slope winds Peary announced in 1898, though he had arrived at the conclusion some years earlier.

TABLE III—EVAPORATION AT CAMP LITTLE AND LAKE TAHOE COMPARED

	CAMP LITTLE AUG. 18–SEPT. 2		LAKE TAHOE AUGUST
	Water	Tundra	Water
Evaporation (inches)	−0.553	−0.416	−7.330
Condensation (dew, in inches)	+0.103	+0.132	
Net balance (inches)	−0.450	−0.284	
Equivalent for 30 days (inches)	−0.90	−0.568	
Temperature (F.)	37° to 51°	46° at 2½″ 39.8° at 4′	
Mean temperature air	44.6°		60°
Average wind velocity (miles per hour)	2.8		3.2
Relative humidity (per cent)	64		25.3*

*At Reno.

The consequences which flow from Peary's law, as they apply both to the continent of Greenland and to that of the Antarctic, were first pointed out by the writer in 1910 and 1911, and the name "glacial anticyclone" has been given to the circulation above these two vast ice mantles.

The theory of the glacial anticyclone involves a large area of air drainage from high levels over the higher interior portion of each of the two continental glaciers, a sliding outward from these interior regions of the air which thus arrives at the surface, and a corresponding indraft of air at high levels to maintain this circulation. The interior region must therefore be an area of high atmospheric pressure, but it is also an area of excessive humidity owing to the ice needles of the cirri brought down with the high-level currents, and it is this ice-derived moisture which on meeting the cold surface of the glacier forms the "frost snow" that nourishes and maintains the two great refrigerating masses of our planet.

This drainage process does not go on at a uniform rate but by pulsations, or strophs, so that the characteristic weather on the slopes of the Greenland continental glacier is an alternation of calms and blizzards. These latter usually develop gradually but end suddenly; corresponding to the mechanism of the process—an outflow of air

due to abstraction of heat and increased air density caused by the refrigerating surface of the glacier, and a sudden termination due to adiabatic elevation of air temperature when the down-slope winds have attained a high velocity and consequent large vertical component, due to the slopes of the ice dome.

Wind Observations in Greenland

A study of the tabulated wind observations from certain of the various meteorological stations near the coast of Greenland[12] has shown that they are chiefly of interest in their indication of the sluiceways for air within their neighborhood. Though they are so near the margins of the inland ice, at some of them the wind records show no high velocities even in the winter season. In part this is explained by the presence of pockets. The early expeditions to Scoresby Sound on the east coast, for instance, brought out the interesting fact that in this tortuous channel at far interior positions there was complete shelter from the wind. Dr. Lauge Koch has more recently shown in far northern Greenland that such pockets exist near the border of the inland ice. In them snow lies unpacked upon the ground even at the end of the winter season. It further appears from his journey across the inland ice that below the contour of 1000 meters the air is quiet because of the steep slope and the overriding of lower air layers by the down-slope winds.[13] At three stations, however—Angmagssalik, Nanortalik, and the former Norwegian station of Mygbugten[14] sluiceways are found which conduct the down-slope winds to the station. For this reason it is found possible at these stations, and these only, to secure records of the winter strophs of the Greenland anticyclone.[15]

The settlement of Holstensborg has maintained a weather station of the second order for a good many years, and through the kindness of Governor Bistrup these records, which are made by an intelligent Greenlander, have been placed at my disposal for the period of the last six years. They show wind velocities as high as nine of the Beaufort scale and that during the winter season such winds come exclusively from the easterly quadrants and are the controlling winds. During the summer season, on the contrary, the controlling winds are generally from the opposite quadrants. A study of the topography about Holstensborg reveals a broad sluiceway for winds from the easterly quadrants, so that observations of strophs should be possible

[12] Meteorologisk Aarbog (Annuaire Météorologique), Publikationer fra det Danske Meteorologiske Institut, Copenhagen.

[13] Hobbs, Glacial Anticyclones, pp. 140–142, Fig. 47.

[14] *Ibid.*, pp. 142–143, Fig. 48.

See also D. Edlund: Die neue Funkwetterstation in Ostgrönland. *Das Wetter*, Vol. 40, 1923, pp. 26–28.

[15] W. H. Hobbs: The January Storms over the North Atlantic and the Strophs of the Greenland Anticyclone, *Monthly Weather Rev.*, Vol. 54, 1926, pp. 286–288.

at this station. In consequence, a Weather Bureau barograph and a Weather Bureau thermohygrograph have been left with Governor Bistrup, and arrangements have been made to secure records throughout the coming year. For measurement of wind velocity, precipitation, etc., the Holstensborg apparatus has been overhauled by Professor Church and Mr. Fergusson, and suggestions have been given for their further use by up-to-date methods.

Observation of Strophs of the Greenland Glacial Anticyclone

While the Expedition was in Greenland during the past season there were two occasions for rather striking observation of summer strophs of the glacial anticyclone. On July 5, when our party was aboard the *Morrissey* and cruising off the coast of Greenland between Sukkertoppen and Holstensborg, a quite remarkable cloud effect was observed to the eastward. The whole eastern horizon on the near side of the coast presented the effect often observed before a thundershower, except that here the whitish gray sky extended north and south over the entire stretch of the visible coast line. Above this was the nimbus cloud, but owing to the great stretch of coast line the effect of perspective was to transform the white area into an elongated flat dome. This entire effect could be explained by cold air riding out from the interior over warmer air beneath. On many occasions when there were easterly winds the characteristic föhn clouds of mushroom shape and bluish color were seen terraced in the sky.

On August 5, the day after our arrival at the border of the inland ice, there came a stroph of the anticyclone, and as we were packing to go on the surface of the glacier, we had great difficulty in advancing against the wind. To rise from the ground with our packs was itself a difficult matter, and once on the surface of the glacier we were several times caught by this down-slope wind and bowled over into a gutter upon the surface. Professor Church has preserved the following record of this stroph:

> At noon of August 5, the day after our arrival, the barometer began falling, reaching its lowest position of 27.90 inches by 3 o'clock the following morning but recovering entirely by 3 o'clock in the afternoon and then slowly rising until noon of the 8th, when the return trip was begun. The east wind, which had prevailed throughout August 5, increased in intensity during August 6, attaining an average hourly velocity for the 24-hour period of 11.8 miles and a maximum of probably 25 miles in the gusts, the wind then dying down throughout August 7 to half the velocity, or an average of 6.6 miles.
>
> The cloudiness increased from 5 per cent on the morning of the 5th, when the stroph began, to 90 per cent at 9 o'clock that evening and continued through the 8th, with average cloudiness of 72.9, 83.3, and 96.6 per cent respectively for the three days. The cirro-stratus clouds, which developed immediately over the ice on the

5th, became lenticular with cirrus background on the 6th, attaining large size and number at the apex of the stroph.

Consequent upon the föhn character of the stroph, the mean temperature on August 6, when the stroph was most active, was 52.5° F. compared with 48.7° and 48.1° of the days immediately preceding and following.

Late on August 7, as the stroph waned, the sky suddenly became overcast and continued thus until the morning of the 9th, with very light precipitation. At the time of overcasting, a west wind was blowing aloft and a west wind also blew at the surface from midnight until morning of the 8th.

FIG. 27—The first *ballons sondes* to be sent up in Greenland. Above, two 32-cm. balloons with attached red silk parachute; below in tandem, a third 32-cm. balloon equipped with Rossby deflating device. Below, and still in tandem (not seen in view), the Fergusson meteorograph, beneath which are three 14-cm. balloons slightly inflated and in contact to serve as a raft in case the meteorograph falls in water. (Photograph by S. P. Fergusson.)

A similar phenomenon was noticed at the head of Akugdlek, August 24–27, when with a falling barometer a clear wind blew from the east, oscillating with rising barometer to the west and accompanied by heavy precipitation. In the latter case, the stroph operated nearer the sea with consequent increase in precipitation. Herein possibly lies the explanation of the anomaly that the weather at Camp Little is fair with falling barometer but stormy with rising.

WIND DIRECTION SHOWN BY TUNDRA VEGETATION

Dr. Samuelsson in an interesting and important monograph[16] has recently shown that in Greenland the direction of prevailing winds is sometimes to be read in the orientation of the tundra shrubs, which spread out upon the ground in the manner of a lady's fan. In such cases the direction of the wind is found in the bisecting line of the fan, the wind quarter being in the direction of the root.

During the trek to the inland ice attention was given to this subject, though not with any thoroughness; and at points not too distant from the inland ice margin such orientation of the tundra plants was observed and believed to be significant.

RESULTS OF AEROLOGICAL EXPLORATION

Aerological observations in Greenland have been made in the past by Drs. de Quervain, Mercanton, Stolberg, and Jost in southwest

[16] Carl Samuelsson: Studien über die Wirkungen des Windes in den kalten und gemässigten Erdteilen (Inaug. Diss.), *Bull. Geol. Inst. of Upsala*, Vol. 20, 1926, pp. 58–230.

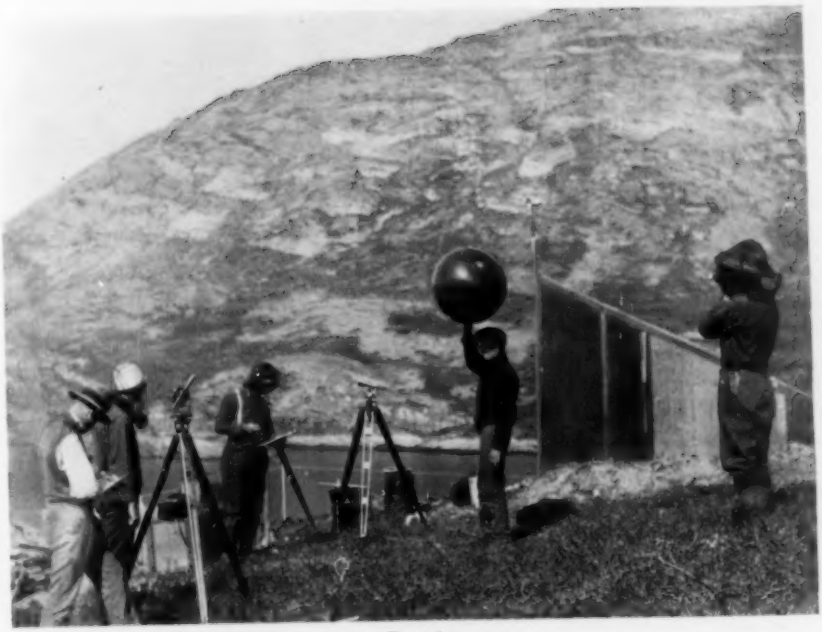

FIG. 28

FIG. 29

FIG. 28—Preparing to send up a pilot balloon at Camp Little. In the foreground the hydrogen generator from calcium hydride. Note the head veils worn as a partial protection against the continual torment of the insects. (Photograph by L. M. Gould.)

FIG. 29—A pilot balloon ascension from the surface of the inland ice. From left to right: Church, Hobbs, Belknap. (Photograph by L. M. Gould.)

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Greenland[17] and by Dr. Alfred Wegener in northeast Greenland.[18] Dr. de Quervain and his associates sent up in all about sixty pilot balloons and made three kite ascensions, the latter at Holstensborg. Of these three kite ascensions, which were to heights of 610, 550, and about 1000 meters respectively, the last mentioned was of greatest interest because it was carried out during a föhn with wind from the southeast. During the three hours and forty minutes of the ascension, the surface air temperature rose from 6.5° C. to 8.7° C., and the relative humidity fell from 45 per cent to 39 per cent.

The upper-air work of the first Greenland Expedition of the University of Michigan was carried out mainly at the base of Camp Little, where after routine had been established three pilot balloon ascensions were generally made each day by Mr. Fergusson. In all over ninety ascensions were made (Fig. 28).

Ballons Sondes Ascensions

Heretofore *ballons sondes* ascensions have been possible only in thickly settled regions where the expensive equipment after its fall is likely to be found and returned. Thanks to the deflating device recently invented by Dr. C. G. Rossby, who generously contributed three of these valves to the expedition, five ascensions of *ballons sondes* were carried out at Camp Little with the use of the Fergusson meteorograph, and four of them were successful. One of the meteorographs was first lost but was afterwards found and has supplied a record to the height of about 8000 meters. These are the first *ballons sondes* ascensions ever to have been made in Greenland (Fig. 27).

Pilot-Balloon Ascensions from Near and Over the Inland Ice

For all balloon ascensions of our Expedition the hydrogen was generated from calcium hydride in a generator built from plans supplied by Dr. Harold Sverdrup, and this modern method of securing hydrogen made it possible to carry out ascensions at and over the inland ice one hundred miles inland. Over the inland ice one of the ascensions was followed with the meteorograph to the height of about 5500 meters. These are the first ascensions by pilot balloon known to have been made either very close to or over the inland ice of Greenland or the Antarctic (Fig 29).

Throughout the season Mr. Fergusson made regular observations of clouds, and all ascensions were carefully checked by comparison

[17] Alfred de Quervain and P. L. Mercanton and others: Ergebnisse der Schweizerischen Grönland expedition (Résultats scientifiques de l'Expédition Suisse au Groenland) 1912–1913, *Neue Denkschr. Schweiz. Naturforsch. Gesell.*, Vol. 53, 1920.

[18] Alfred Wegener: Drachen-und Fesselballonaufstiege ausgeführt auf der Danmark-Expedition 1906–1908, *Meddelelser om Grønland*, Vol. 40, 1909, pp. 1–75.

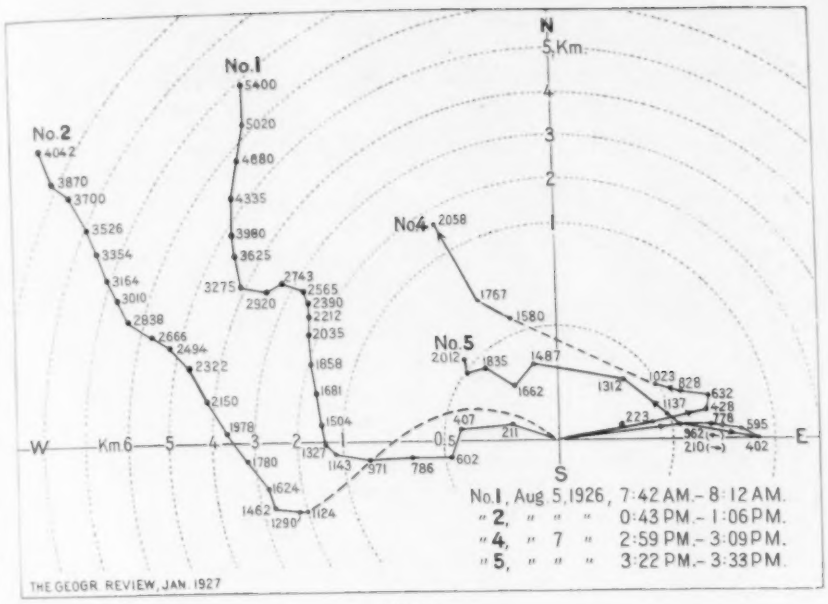

FIG. 30

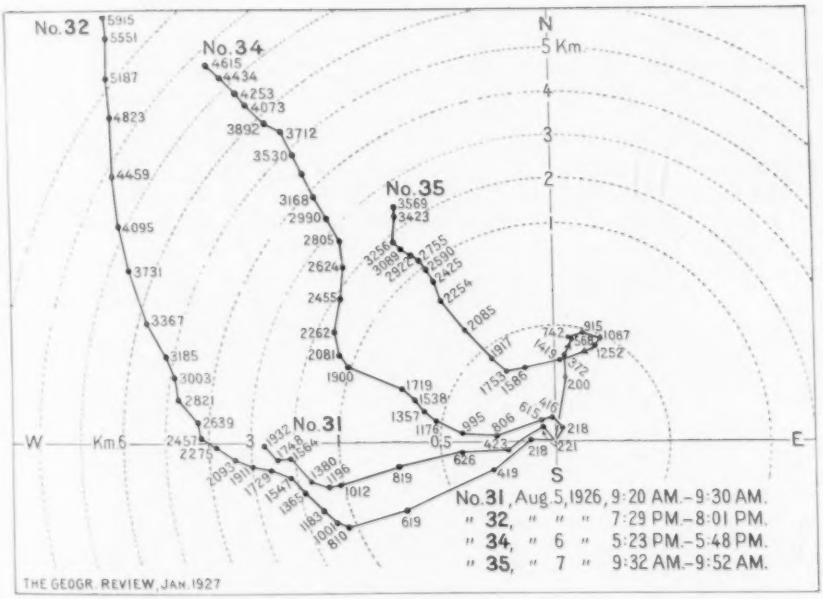

FIG. 31

FIG. 30—Plan of pilot balloon ascensions 1, 2, 4, and 5. Ascensions 1 and 2 from Camp Cooley near the margin of the inland ice (Fig. 4) on August 5, 1926. The elevation of Camp Cooley is about 300 meters. Ascensions 4 and 5 from the surface of the inland ice on August 7, 1926.

FIG. 31—Plan of pilot balloon ascensions 31, 32, 34, and 35 at Camp Little. Ascensions 31 and 32 on August 5, 1926: Ascension 34 on August 6 and 35 on August 7.

with these cloud observations. The following quotations are from his preliminary report:

Assuming that during the summer the bottom of the stratosphere is in this region about 9000 meters above sea level, the highest velocity of the cirrus recorded was 20 meters a second, and the average of all observations is probably less than one half that figure, or about one half the velocity observed in lower latitudes. If the upper winds tend to blow toward the ice cap, as indicated by earlier observations of cirrus in Iceland, there should be an acceleration of the prevailing westerly winds on the west coast and a decided increase of velocity with increase of height; this evidently does not occur in summer. It is hoped that the cloud observations that were to be made the past summer by Dr. Thorkelson in Iceland will throw further light upon this question.

The vertical gradients of temperature shown by the ascensions of *ballons sondes* appear to be of the same character as those observed elsewhere. Lapse rates of 0.6° F., 0.7°, and 0.8° per 100 meters were obtained. Strong convectional currents, indicated by massive cumulus clouds, ascended frequently and extended to considerable heights, although no thunderstorms were observed.

From the few records of pilot balloons so far evaluated, as well as from the observations of clouds, it appears that the changes of direction of the winds resemble those occurring at lower latitudes, in that the directions become more and more frequently from some westerly point as the height increases. The proportion of winds from easterly directions at the cirrus level appears to be slightly greater than is the case in eastern America, but it is possible that this excess may be normal wherever the velocities are as low as those recorded in western Greenland.

The two groups of ascensions made on August 5–7 at Camp Little and over the ice cap show nearly the same changes of direction and velocity of wind at approximately the same heights; and while it must be emphasized that the data of ascensions not yet computed cannot be evaluated accurately by inspection, it appears from examination that the southeasterly winds long ago observed at the surface extend to and prevail at heights exceeding 1000 meters, becoming gradually southerly or northerly and finally westerly before the stratosphere is reached (Figs. 30 and 31).[19]

The two groups of ascensions referred to were made during the same type of weather, hence they may not represent the average or a prevailing condition.

The computations necessary to the full study of the ascensions—more than ninety—carried out by the Expedition are now being made by Mr. Fergusson, and they will be published elsewhere.

Survey, Geological and Tidal Studies and Radio

In addition to the cartographic data which appear upon the official maps of that part of the Holstensborg district which we have examined (Fig. 2), Nordenskjöld has a sketch map, based upon his exploration in the summer of 1909,[20] delineating a route to the inland ice—an ancient caribou hunter's trail across the tundra—which we have largely followed. It is a pleasure to bear witness to the accuracy of Nordenskjöld's observations, something quite remarkable when one considers the brief time which he was able to devote to this particular

[19] Cf. Hobbs, The Glacial Anticyclones, pp. 76–77; also *Proc. Amer. Philos. Soc.*, Vol. 54, 1915, p. 214, Fig. 7.

[20] Nordenskjöld, Einige Züge der physischen Geographie, p. 433.

FIG. 32

FIG. 33

FIG. 32—A detail view of two of the terraces shown in Figure 9. A special study of terraces has been made by the Expedition. (Photograph by L. M. Gould.)

FIG. 33—Remarkable example of insolation from the high plateau east of Camp Little. The slab of gneiss which had been raised up from its bed is about eight feet in length. Similar bendings up may sometimes be observed in cement sidewalks during the summer heat. (Photograph by W. H. Hobbs.)

district. As he makes clear, the region is one of marked relief deeply incised by fiords and covered with numerous lakes in the plateau levels.

With the assistance of other members of the Expedition Mr. Belknap has completed the triangulation of an area of about 1000 square miles, lying mainly within the outer belt of high and rugged topography and largely to the eastward of Camp Little. This has required the measurement of a preliminary base line and the occupation by transit of a score of high stations at which bamboo poles carrying flags had first been set up. These stations for the most part had altitudes varying from 1000 to more than 4000 feet. Plane-table maps have been made of the shores of Maligiak Fjord and of the vicinity of Camp Little (Fig. 3). A line of levels from tidewater to the margin of the inland ice has been begun and already carried some distance to the eastward of Lake Taserssuak. This work is to be resumed next season, and it is hoped to continue the profile up onto the inland ice to the end that barometric readings upon the glacier may be properly interpreted.

Although the sculpturing agent which has largely determined the form of the relief within the Holstensborg district has been glacial ice, the lines within the pattern displayed are elements of a fracture network outlined by nearly vertical planes comprised within a very simple system—a rectangular checkerboard design (Figs. 23 and 26.) The bounding planes of the units are in most instances clearly faults, and these stand nearly perpendicular to the surface. The master lines are nearly parallel and perpendicular to the meridian, which directions are also followed by the course of the principal fiords that appear on the map (Fig. 2). The escarpments presenting major features in this pattern are being entered on the map that is in preparation by Mr. Belknap, who is making a special study of the structure.

Though the coastal region in this part of Greenland is one of great subsidence, as is testified to by the deep fiords penetrating far into the country, later repeated uplifts are recorded as well by marked terraces represented by a number of stages. While these are most frequently found cut in the heavy deposits of glacial clay (foreground of Fig. 20), many are leveled off in the hard crystalline rock (at the left of Fig. 20 and at many places in Fig. 22). Farther back in the hinterland the terraces take on a different aspect and are to be correlated with successive blockings and unblockings of drainage lines by a low-level tongue that formerly issued from the inland ice (Figs. 9 and 32). Professor Gould has made a special study of the terraces observed by the Expedition. Nordenskjöld has devoted an important section of his report to the terraces and particularly the coastal platform, but he has given no very clear pronouncement with respect to origin.[21]

[21] *Ibid.*, pp. 434–441.

A standard tide gauge was loaned the Expedition by the Superintendent of the Coast and Geodetic Survey, and this was early set up at Camp Little, though it offered some difficulties because of the large range of the spring tides—over twelve feet. A tube of sufficient length, however, was constructed by Mr. Belknap from our scant supply of lumber, and after various adjustments had been made by Mr. Fergusson, who replaced the stiff original markers with the Weather Bureau type of pen, some quite satisfactory records were produced which are to be turned over to the Coast and Geodetic Survey for study.

Space will not permit discussion here of the interesting results obtained at the wireless station. All previous work with radio in Greenland has been limited to the seacoast stations of the Danish government, which all employ the long wave lengths. John L. Reinartz, when operating for the Macmillan Expedition of 1925, set up a short-wave station on shore near the ship when in the Cape York district and maintained it for a brief period.

As a first experiment our 35-foot mast was set up, and a station was established within the rock amphitheater in which Camp Little is located, but with only meager results. The station was then removed to the summit of a projecting headland, Radio Point, at the southern entrance to University Bay. Here the Reinartz rule that rising land masses about the station shall not project above an 18° arc with the horizontal was met upon all sides but the southeast. At once the new station established connection with very remote points. In fact, conditions here approached the ideal.

Preparations for the Expedition of 1927

In preparation for the Expedition of 1927 supplies have already been taken to Camp Little where they are in storage. These include considerable equipment, some of which was used the present year, and also provisions. Lumber was taken from Canada and a small storehouse constructed. About 100 gallons of aviation gasoline and 50 gallons of fuel gasoline are now stored in steel drums at Camp Little. Two Chestnut canoes and a dory and valuable instruments of precision are in the care of Governor Bistrup at Holstensborg.

During the present season 20 gallons of kerosene, bamboo poles to be used as markers upon the inland ice, furs, rope, and certain other equipment were packed in to Camp Cooley and cached there near the margin of the Otto Nordenskjöld Glacier. Arrangements have been made with Governor Bistrup to have 200 pounds of pemmican, over 100 pounds of other nonperishable provisions, and certain equipment all taken in by dog sled during the late winter before the lakes have opened or the ground has become bare of snow.

CHAN-CHAN: CAPITAL OF THE GREAT CHIMU*

Otto Holstein

A FEW hundred miles northwest of Lima and about four miles west of the city of Trujillo lie the ruins of Chan-Chan, probably one of the greatest cities in the western hemisphere in pre-Columbian times. It was the capital of the Great Chimu, a ruler who extended his sway for five or six hundred miles along the Peruvian coast and who built monumental structures in which are preserved the records of a resourceful and once powerful race. But of it we know comparatively little. The Incan civilization, in its heyday when the Spaniards arrived, has dwarfed interest in its predecessors in the Central Andes, both in the mountains and on the coast. Chan-Chan has been known from the earliest descriptions of the Spanish *conquistadores* and has attracted some scientific notice, but systematic study is urgently needed before earthquakes and rains and treasure seekers complete their work of destruction. The writer's purpose in describing the present state of the ruins and publishing the accompanying photographs is to call attention to this need. It was in particular brought home to him by witnessing the disastrous effects of the rains of March, 1925. The setting and relationships of the area offer much of geographical as well as archeological interest.

Site of the City

The ruins of Chan-Chan cover an area of about eleven square miles, and the entire city was enclosed within a high wall. If we assume that the whole of the site was occupied at one time, it may have had a population of two hundred thousand or two hundred and fifty thousand souls, as Montesinos and other early historians concluded. We know, however, that the tendency in such estimates is toward exaggeration, so that the population may well have been smaller. Wiener,[1] after a study of the site, thought that the cultivated area was ten times as extensive as the cultivated area about Trujillo today and that the population was possibly three times as great. The city stands in the midst of a fertile and well-watered section of the coastal plain, on an imposing site—the blue Pacific on the one hand and the

*The author wishes to acknowledge his indebtedness in the preparation of this paper not only to the authors of the works cited but to his personal friends, especially Doctor Ricardo Rivadeneira, Señor Garrido, and the Reverend Father Antonio de Alcelay. These have supplied important papers, notes, and manuscripts from the local archives and have offered other valuable information.

[1] Charles Wiener: Pérou et Bolivie, Paris, 1880, p. 542.

great wall of the Andes on the other. It has an equable climate, sunny, but cooled for almost the entire year by a southerly breeze. Chan-Chan means in the Chimu tongue "Sun-Sun."

The region is practically rainless under normal conditions.[2] The Moche River descends from high Andean sources as a full-channeled

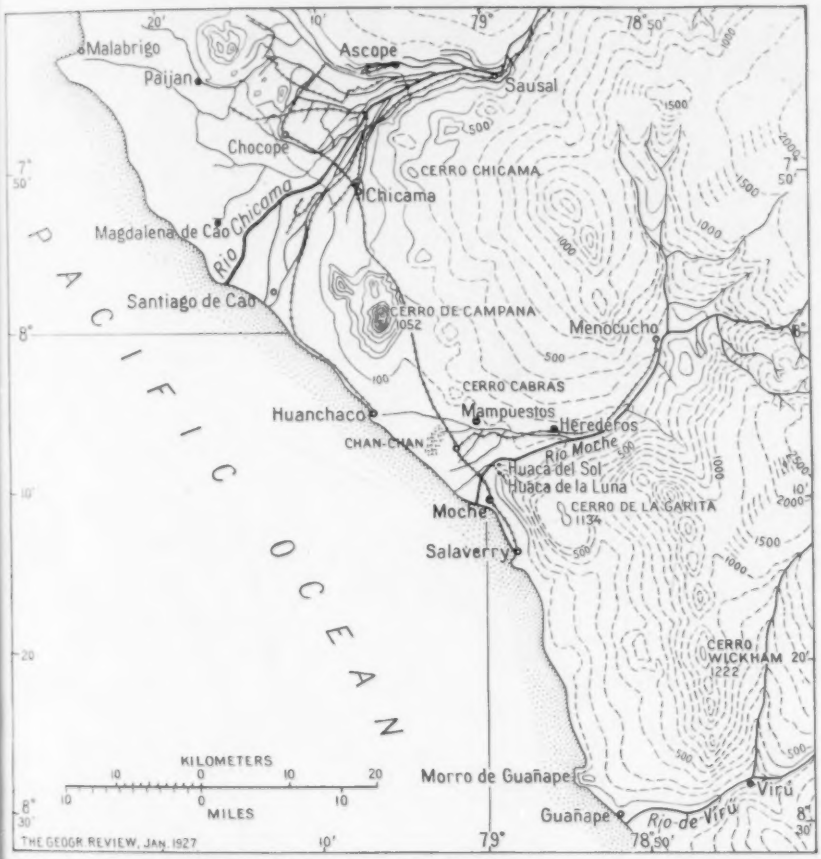

FIG. 1—Map of the vicinity of Trujillo showing the site of Chan-Chan. Drawn from the compilation prepared for the Trujillo and Piura sheets of the American Geographical Society's Millionth Map of Hispanic America. Scale 1:0,000,000. For general relations see the map, Figure 4.

stream for part of the year, and this made possible the building of a widely ramifying and scientifically constructed series of irrigation canals. Not only that, but the Chimu peoples knew how to construct reservoirs to conserve the water for the drier season. Under such conditions it was possible to raise several crops a year. We may assume that the whole region was intensively cultivated. "The marks

[2] See the note "The Extraordinary Rains and Floods in La Libertad, 1925," elsewhere in this number of the *Review*.

FIG. 2

FIG. 3

FIG. 2—Part of the ruins of Chan-Chan. City of Trujillo in the distance. The *huaca* Esperanza in the foreground.

FIG. 3—Chan-Chan looking toward the Pacific.

of the furrows are even to this day visible," says Rivero,[3] and one may make out just such marks today (Fig. 25). They are precisely like those made by the plow and are found in the fields in the neighborhood of the ruins. In addition to the immediate site the valleys north and south along the coast for hundreds of miles were tributary to the Great Chimu and were probably drawn on and exploited after the immemorial practice of expanding empires.

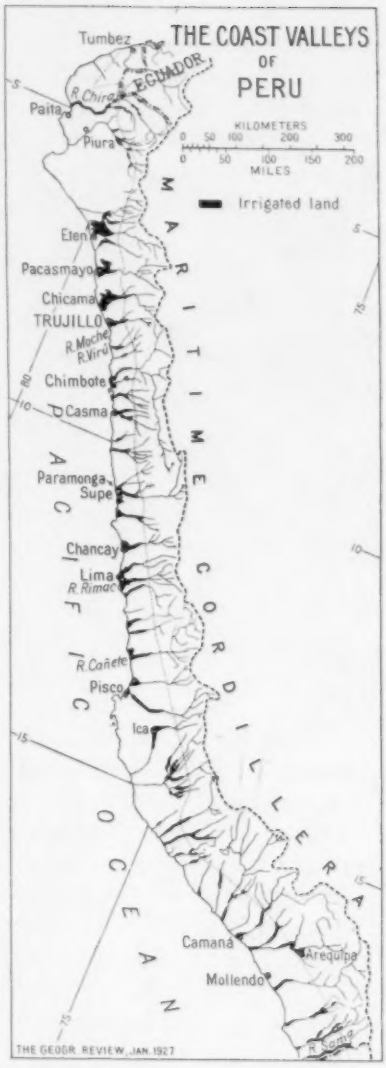

FIG. 4—Map showing the valleys and irrigated land of the Peruvian coast. The dotted line between the crest of the Maritime Cordillera (shown by a dashed line) and the shore line delimits the mountain zone of annual rains and the coastal zone of rains at intervals of several years. Scale approximately 1:13,500,000.

THE COAST VALLEYS OF PERU

To understand the importance of the site and its place in the culture of its time we may well take a brief excursion into the history of the coastal peoples, keeping in mind the well marked physical environment in which that history unfolded. Not only did the geographical features of the region leave their impress upon the material culture; they at the same time limited the scope of activities of the coastal peoples and in the end had much to do with their final conquest.

The coast of Peru is marked by a variety of terraces, alluvial fans, widespreading deltas, narrow coastal plains, and uplifted wave-cut shelves that result in a patchy distribution of arable land. There are about thirty main rivers that come down from the Andes flowing through alluvial valley floors and debouching upon the widespreading alluvial fans and deltas they have built up.

From the human standpoint it is the distinguishing feature of the

[3] M. E. Rivero and J. J. von Tschudi: Peruvian Antiquities, transl. by F. L. Hawks, New York, 1853, p. 264; quoted from Rivero's earlier work of 1841.

cultivated and watered tracts that they are relatively small in size and separated from each other by wide expanses of desert or arid mountain spurs and isolated ranges. The result of these physical circumstances is well marked in the history of the coastal peoples. At the time of the Inca conquest, just before the coming of the Spaniards, four major coastal states had come into being, after a history of conquest and re-conquest about which we know but little today

FIG. 5—General view of Chan-Chan looking seaward (west).

and shall know little until extensive archeological work has been done. On the north, from Tumbez to Casma, the country was under the rule of one known to the Incas as Chimu-Capac, or the Great Chimu. Farther south the Rimac valley at the present site of Lima and other valleys were under another ruler or chief. Still farther south was a third, and the southernmost valleys of Peru, including the regions of Ica and Pisco, were under the rule of a fourth chief.[4]

ANCIENT CULTURES

Hrdlička has given a description of the material culture.[5] The houses were built of reeds or of small uncut stones or sun-dried bricks or blocks. Their larger structures known as *huacas* served a double purpose—as places of ceremony and of burial. The arts of weaving, using the native cotton and llama wool, and of pottery making were well advanced. Both the textiles and the decoration of the pottery show a considerable variation from place to place and from time to time. To a limited degree the people knew how to work copper,

[4] P. A. Means: A Survey of Ancient Peruvian Art, *Trans. Connecticut Acad. of Arts and Sci.*, Vol. 21, 1917, pp. 315–442; reference on p. 329.

[5] Aleš Hrdlička: Anthropological Work in Peru in 1913, with Notes on the Pathology of the Ancient Peruvians, *Smithsonian Misc. Colls.*, Vol. 61, No. 18, Washington, 1914.

silver, and gold, though they had few or no stone implements. They had copper axes and hoes, wooden clubs, copper knives, slings and bows-and-arrows, as well as metal or stone maces that served as weapons. They had needles of bone or cactus spine; and the fishermen had nets and sinkers, reed boats or *balsas*. They had practically no precious stones; but they used beads, seeds, feathers, yarn, and cloths as well as metal objects for personal decoration. In their

FIG. 6—General view of Chan-Chan looking northeast. The *huaca* Esperanza in the distance.

pottery they made frequent use of molds and stamps "and were masters at imitating natural objects and animals as well as man."

Their pottery in particular furnishes valuable evidence of the cultural and geographical relationships of these people. Several strata are recognizable. In the northern coastal region, with which we are here concerned, the earliest stage is known as proto-Chimu. It is a red-and-white ware and is identified by its antiquity and stylistic uniformity and purity. Kroeber[6] considers its technical and aesthetic qualities such as could only be produced by a population prosperous for some time and possessed of economic surplus and leisure. Like the proto-Nazca culture farther south, it is known only in its full bloom. Kroeber draws the general conclusion that the proto-Chimu, for all its aesthetic superiority, remained a local style occurring but sparingly in adjacent coastal regions. It seems to have developed at a time when there were limited communications between the coastal groups and probably when the people were divided into restricted political units. On historical grounds Means dates this epoch as prior to about 500 A. D.[7]

[6] A. L. Kroeber: The Uhle Pottery Collections from Moche and the Uhle Pottery Collections from Supe, *Univ. of California Publs. in Amer. Archaeol. and Ethnol.*, Vol. 21, 1925, pp. 191–264.

[7] P. A. Means: An Outline of the Culture-Sequence in the Andean Area, *Proc. 19th Internatl. Congr. of Americanists Held at Washington, Dec. 27–31, 1915*, Washington, 1917, pp. 236–252.

The succeeding period shows the penetration of Tiahuanacan influence. Spreading from the Titicaca region this megalithic culture gave a characteristic stamp over a wide area (see Fig. 22). A period of debased types followed, and then local styles reappeared, notably in the red-white-black ware and in the Chimu ware, the last finally showing a minor Incan influence.

Origin of the Race

All who have written of the coastal peoples assume that earlier primitive periods of development must have existed, yet no traces have so far been found. One of the outstanding objects of archeological research in Peru today is to ascertain whether excavations in the coastal area will not disclose a center of culture from which the proto-Chimu and proto-Nazca were derived. Failure in this attempt would apparently leave no other hypothesis than that of direct importation of ready-made culture from farther north, presumably from Central America.

Anatomical and particularly cranial studies show that the Peruvian coast for a space of about six hundred miles was peopled by a well marked physical type of Indian.[8] "The coast population . . . was, barring some intrusions from the mountains, of the Maya type and same derivation."[9]

More light on the origin of the race might be shed by a study of the philology. The inhabitants of Chan-Chan spoke a language known as Yunga (or Yunca) or Mochica of which today vestiges survive in the vicinity of Eten. In the year 1644 Fernando de la Carrera wrote a grammar, "Arte de la lengua Yunga," only three copies of which are known to exist. It was reprinted in a limited edition in 1880 under the care of Cárlos Paz Soldan, and, based on this, a version by Federico Villareal of the University of San Marcos was published in 1921.[10] Dr. Villareal includes a list of Mochica words of current speech collected from an inhabitant of Eten. Squier says "The inhabitants of the Indian village of Moche still speak in confidential intercourse, the ancient language of the Chimus, which, from all I can learn, is identical with that spoken in the village of Eten . . . "[11]

[8] Hrdlička, *op. cit.*

[9] Aleš Hrdlička: The People of the Main American Cultures, *Proc. Amer. Philos. Soc.*, Vol. 65, 1926, pp. 157–160; reference on p. 159.

[10] Fernando de la Carrera: Arte de la lengua Yunga de los valles del Obispado de Trujillo con un confesonario y todas las oraciones cristianas y otras cosas, Lima, 1644; 2nd edit., Lima, 1880.

Federico Villareal: La lengua Yunga o Mochica: Segun el arte publicado en Lima en 1644 por el licenciado D. Fernando de la Carrera, Lima, 1921.

Attention was called to these works by Prof. M. A. Saville. Copies of the 1880 and 1921 volumes are in possession of the Museum of the American Indian, Heye Foundation, New York.

[11] E. G. Squier: Peru: Incidents of Travel and Exploration in the Land of the Incas, New York, 1877, p. 169.

FIG. 7

FIG. 8

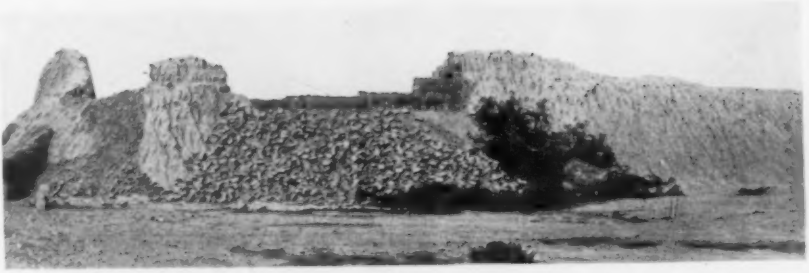

FIG. 9

FIG. 10

FIG. 7—Fortifications, Chan-Chan. The walls here are from 50 to 60 feet high.
FIG. 8—Walls of buildings at Chan-Chan. Note the reed protruding from top of wall at right.
FIG. 9—Part of the fortifications of Chan-Chan.
FIG. 10—House ruins at Chan-Chan.

FIG. 11

FIG. 12

FIG. 11—An interior view in the palace of the Great Chimu.
FIG. 12—A street in Chan-Chan.

FIG. 13

FIG. 14

FIG. 13—An interior view of the palace of the Great Chimu, taken before the rains.
FIG. 14—Ruins at Chan-Chan. Note checker-board motif on wall in center.

FIG. 15

FIG. 16

FIGS. 15 and 16—A decorated ramp at Chan-Chan. These pictures were taken respectively before and after the rains of March, 1925.

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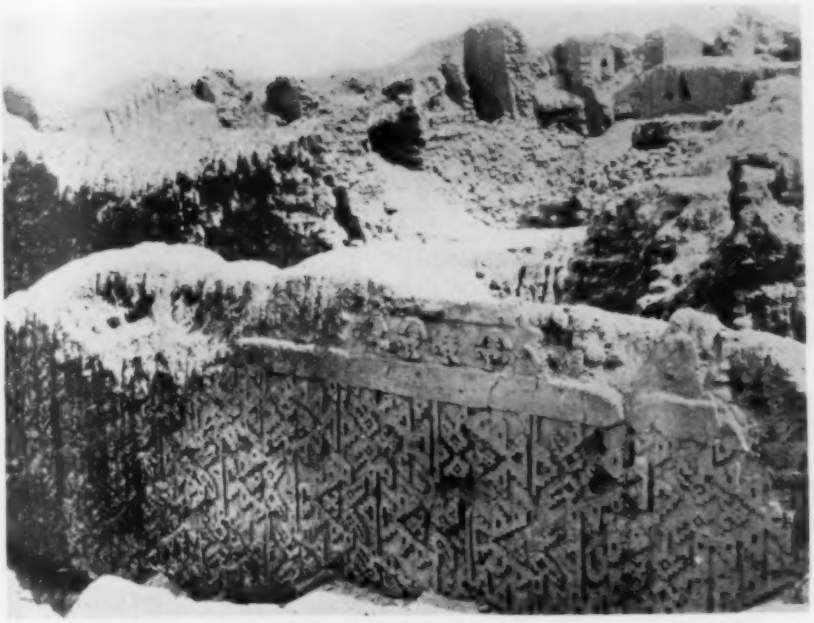

FIG. 17

FIG. 18

FIGS. 17 and 18—An interior view in the palace of the Great Chimu, taken respectively before and after the March rains. The top frieze of legendary animals in Figure 17 has now entirely disappeared.

FIG. 19

FIG. 20

FIG. 19—Part of the defensive walls at Chan-Chan.
FIG. 20—Ruins at Chan-Chan showing damage caused by erosion.

History and Legend

Historical evidence gives support to archeological conclusions regarding the civilizations of the Central Andean region. Means has sifted the evidence. In a recent paper he discusses the merits of the chief sources, including Montesinos.[12] Important checks on the much disputed work of that writer are the chronicles of Fathers Miguel Cabello de Balboa and Antonio de la Calancha, written respectively in the latter half of the sixteenth and the first half of the seventeenth centuries. Both afford interesting particulars of the coast civilizations, and both lay stress upon the fact that the coast population after it had increased to a certain point was hard put to find enough food. Cabello attributes the folk movements on the coast chiefly to the need of more land. Cabello is the only authority that gives any tradition respecting the origin of the coast people. He narrates the legend of the people of the Trujillo region.

In the dim past their ancestors came from the north by sea, arriving by means of a great fleet of *balsas*, or rafts. The legend describes the newcomers as highly organized, with all the distinctions and services of a court. Upon the death of the ruler there were eleven successors, at the end of which time the country was formed into a republic in which state it existed for a long time until the powerful chief Chimu-Capac in the Chicama valley came into power. He extended the borders of his dominion, making vassals of conquered peoples and putting over them governors responsible to him. Thus both north and south the dynasty of the Chimus exacted tribute, and by this means and the development of their own particular province the Chimu kings built up a state of magnificence and ceremonial that no doubt augmented in a moral way their material power. Archeological records bear this out. The early coast pottery portrays scenes from a well developed court life, and its importance is just in proportion to its realistic character. It had not yet become sufficiently generalized or conventionalized to obscure the life and history of the people. The tendency toward conventionalization makes such evidence of less and less value as time goes on. Thus the Tiahuanacan of the highlands had advanced so far in the process of conventionalization that it has less documentary value.

It is hardly necessary to say that the legends and traditions are not to be accepted in their entirety. However, they give an approximate idea of the age to which they relate and the source and the history of the peoples concerned, and that they are authentic in parts is well shown by their references to some of the physical features of today—the terrible floods that were followed by pestilence and hunger, as recited by Cabello de Balboa.

[12] P. A. Means: A Study of Ancient Andean Social Institutions, *Trans. Connecticut Acad. of Arts and Sci.*, Vol. 27, 1925, pp. 407–469. See also the volume on Montesinos, "Memorias antiguas historiales del Peru," in the Hakluyt Series (Ser. 2, Vol. 48, London, 1920) translated and edited by Means.

With the coming of the Incas the history of the coastal region took on new significance. If the Chimu rulers had advanced into the Andean region before the Inca period, which is the view of the historian Montesinos, these incursions were stopped by the Incas by means of fortifications on the west, just as similar fortifications in key situations mark the outposts of empire on the eastern border of the cordillera during the Inca and pre-Inca periods. When the Incas entered on their policy of expansion the Chimus, encouraged by the ease of life in their fertile valleys and the tribute due their earlier conquests, appear to have lapsed into a state of laxity and sluggishness. The decisive battle between the two Empires was fought at Parmunca (Paramonga, see Fig. 4). This Chimu fortress was on the same general lines as Chan-Chan, the same stuccos, paintings, and the like. Of its three parallel lines of adobe walls the exterior measured seven hundred and the inner six hundred feet in length, and they had salients that extended ninety feet forward. Failing in direct assault upon the stronghold, the Inca took his position on the high grounds and, in the foothills near Chan-Chan, possessed himself of the ravines and river courses that supplied the plain with water. There, by constructing dams and diverting the streams, he brought about a terrible drought; he also threatened to deprive the Chimus of the light, as he had deprived them of water, if they did not capitulate. Their capital was destroyed, and many of the people were transported to other provinces, the remnants of population being left with local chieftains as governors, tributary to the Inca. These events took place about the year 1400, or 130 years before the coming of the Spaniards.

FIG. 21—Figures in high relief on wall.

THE RUINS AND THEIR APPEARANCE TODAY

With this brief outline of the history and cultural character of the coastal peoples we may turn to a more detailed description of the ruins themselves as they now appear. They are particularly interesting in their present aspect because of the effects of the destructive

rains of March, 1925, mentioned above.[13] The accompanying photographs show quite clearly how great were the effects of the falling rain and the rainwash and what serious losses will be sustained if there is any further delay in the systematic and thorough study of these notable structures. At first view the ruins present the appearance of a labyrinth, a confused jumble of fallen walls and débris, but closer observation reveals streets, courts, walls, houses, reservoirs, and sunken gardens laid out with great skill and exactness. The ruins of great palaces with their halls, gardens, and spacious patios are still to be seen. The city itself, the gardens, fields, and patios were once well-watered by a great canal which now only appears as the bed of a dry creek or brook leading from the river Moche.

FIG. 22—Map showing the pre-Inca cultural regions of the Central Andes. After Map 1 in P. A. Means: An Outline of the Culture Sequence in the Andean Area, *Proc. 19th Internatl. Congr. of Americanists, Held at Washington, Dec. 27–31, 1915*. Washington, 1917.

The structures are of *cascajo* (coarse gravel) mixed with a cement-like mud into a material of great consistency and strength. The walls are quite high and of considerable thickness, some of them rising to 30 or 40 feet with a thickness of nine or ten feet at the base, and inclined slightly inward with their surfaces converging toward the top to give them greater stability. At the tops, abraded by the winds and eroded by the rains, which come at rare intervals, are to be seen the tips of reeds (Fig. 8), apparently used as guides to mark the courses of the walls during the process of building. From paintings on some of the pottery unearthed in the ruins we know that the roofs had considerable slope and that they terminated in a ridge of adobes or sun-dried bricks. Squier[14] comments as follows: "The roofs were not flat, but, as shown by the gables of the various buildings, sharply pitched . . . " The doorways, like the walls, converged toward the top. They were closed

[13] For a general account of the rains on the Peruvian coast see R. C. Murphy: Oceanic and Climatic Phenomena Along the West Coast of South America During 1925, *Geogr. Rev.*, Vol. 16, 1926, pp. 26–54. Data and photographs for Truiillo were furnished by the present writer.

[14] *Op. cit.*, p. 161.

by reed mats or by skins, since carpentry was little developed. Trees are scarce along the coast, and timber from distant sources was not available. In construction work hewn wood was used, as shown by Squier, who reports the recovery of a beam of algarroba wood five feet long and nine inches by five inches in cross section supporting the roof of a passage. Despite the limited occurrence of the material the

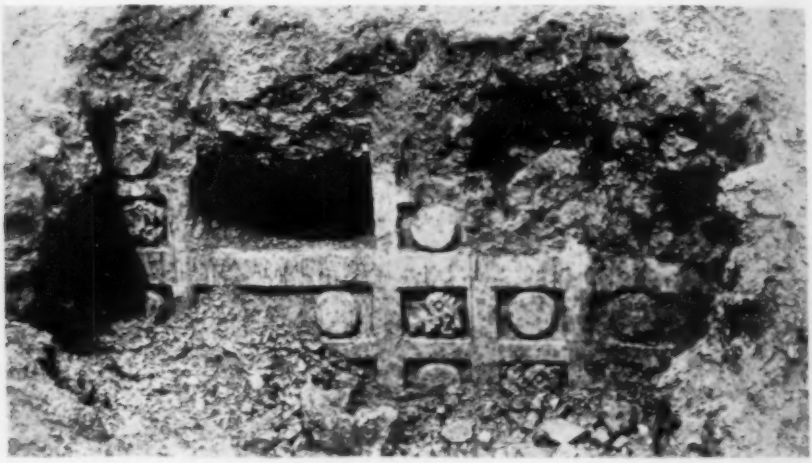

FIG. 23—Burial niches in wall.

people were masters at wood carving, as is attested by remarkable examples taken from the ruins.

Within the angle formed by the roof and in the center of the walls opened windows of circular form. From appearances the houses were but poorly ventilated, the principal function of the windows being to allow the escape of smoke. Some of the edifices—temples in all probability—were built on mounds especially raised for the purpose, calling to mind the ruins of Uxmal, Palenque, and other places in the north. Some notable *huacas*, or burial mounds, still exist, the largest of these being Esperanza (formerly known as Del Obispo) today badly defaced by the ruthlessness of treasure hunters. This *huaca* contains fifty million cubic feet of material. The most famous of all the *huacas*, however, is El Peje Chico (The Little Fish) or Toledo, from which considerable treasure in the form of gold and silver objects has been taken. Hutchinson[15] obtained from a reliable countryman a treasure record copied from the original accounts in the archives of the municipality of Trujillo. The entries were taken from the book of "Fifths of the Treasury" for the years 1577 and 1578 and refer to the Royal Fifth which was paid into the treasury

[15] T. J. Hutchinson: Two Years in Peru, with Exploration of Its Antiquities, 2 vols., London, 1873; reference in Vol. 2, pp. 153–160.

as a tax, determined on the basis of the weight of the gold and silver objects. The figures relate exclusively to the Huaca of Toledo. In 1577, at two different dates, 11,318 gold pesos (Spanish dollars) were paid in. In 1578, on six different dates, additional sums totaling 266,856 gold pesos were paid. Rivero and von Tschudi[16] report that from the books of the royal coffers of Trujillo of 1566 Gutierrez

FIG. 24—Post office box-like receptacles in wall.

of Toledo recorded the king's fifth as 85,547 dollars in gold (also from the Huaca of Toledo); and in 1592, 47,020 dollars. Middendorf[17] makes a critical comparison of the statistics available and concludes that the total of the king's fifth between 1566 and 1592 recovered from the Huaca de Toledo amounted to 941,054 gold dollars, which means that the value was perhaps little less than one-and-one-half million dollars at present standard of currency, not taking into account the difference in the value of money between then and now. Since this sum represented the king's fifth only, the total value of the treasure recovered from this one spot was between five and seven million dollars.

The palaces were rectangular in form, and some of them covered as much as 600,000 square feet. One in particular is unique in that it has nine rows of small cells, in groups of five, numbering 45 in all, each 14 feet long by 8 wide and 9 high. It has been thought that these were for prisoners, since the walls at this point have large stones imbedded in them. In other parts of the ruins, however, these small cells are found but without excessive strength of walls, so that they may well have been used to store treasure, clothing, utensils, arms,

[16] *Op. cit.*, p. 268.

[17] E. W. Middendorf: Peru: Beobachtungen und Studien über das Land und seine Bewohner 3 vols., Berlin, 1894; reference in Vol. 2, p. 379.

FIG. 25

FIG. 26

FIG. 25—Walls of Chan-Chan. Note marks of plow furrows in foreground.
FIG. 26—A view of Chan-Chan looking east. The *huaca* Esperanza in the distance.

FIG. 27

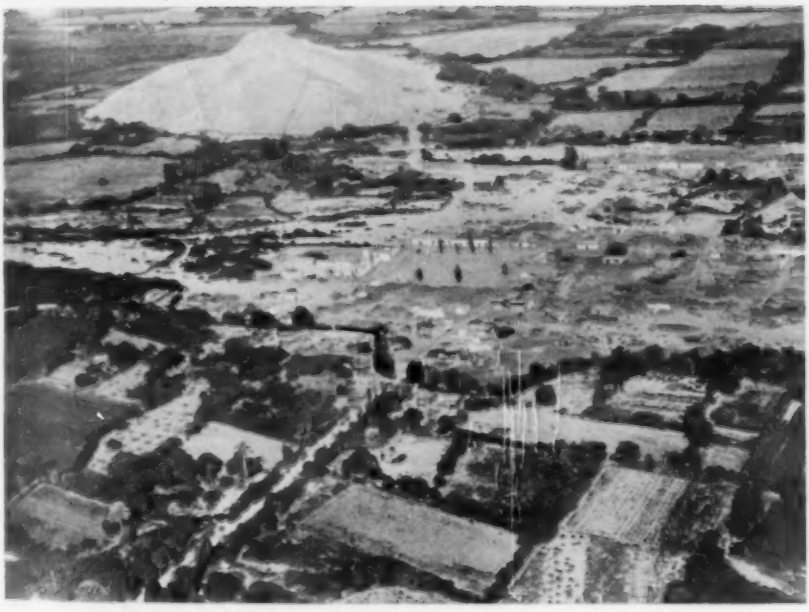

FIG. 28

FIG. 27—*Huaca* in the Chicama valley with ruins of a Catholic church built thereon.
FIG. 28—The town of Virú with *huaca* near by.

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FIG. 29

FIG. 30

FIG. 29—The Huaca of the Sun (see Fig. 1). Trujillo is to the right beyond the lowest part of the *huaca;* beyond the highest part, on the horizon, is Huanchaco; midway between the two points lies Chan-Chan.

FIG. 30—Near view of the Huaca of the Sun, showing the terrible damage caused by erosion and slides as a result of the rains of March, 1925.

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FIG. 31

FIG. 32

FIGS. 31 and 32—Mural paintings, Huaca of the Moon. The colors used are black, reds, orange, yellows, and blues on a white ground. Some figures have been sketched in but not colored.

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or the like. Another palace which, according to Feyjóo de Sosa[18] (a political officer in the time of the Viceroy de Superunda during the reign of Carlos III, 1745 to 1761), belonged to the chief, is peculiar in that it is built adjoining the *huaca* of Yomayocgoán. This *huaca* was the burial place of the sovereigns of the Chimu. It incloses various galleries and small rooms lined with honeycomb-like niches in the opposite walls on both sides of the entrance, and it was near these that the Spaniards found mummies dressed in richly woven woolen garments and adorned with gold and silver ornaments in the form of fishes and other animals. Among other objects found, we are told, were some that represented insects in which "the center of gravity was so well studied that when thrown into the air they imitated flight before falling to the earth." The walls of the principal room of this great palace measured 45 feet in length. Adjoining it was a sort of living room whose walls were wonderful examples of the mason's art. A number of doors gave access to other smaller rooms. This may have been the living room of the ruler, and the other smaller ones those of his wives and concubines.

FIG. 33—A wonderful example of Chimu or pre-Chimu pottery of the earliest period. This particular piece represents a funeral scene.

The walls of both palaces and of many other buildings—possibly all of them—were profusely decorated in high relief, some worked in plaster in the form of animals, stars, leaves, circles, and complicated interlaced lines similar to some of the Chinese ideographs and executed with admirable regularity and precision. The friezes stood out from a painted background of bright colors which have entirely disappeared but which have been seen by some of the oldest inhabitants now living in Trujillo. The climate and relatively dry atmosphere aided greatly in the preservation of these decorations. Some particularly interesting mural paintings from the near-by Huaca of the Moon (see Fig. 1) are shown in Figures 31 and 32.

Tanks, baths, gardens, and avenues adorned the city. The tanks are still to be seen, and the fact that they were dug down to water is attested at this day by the existence of green plots upon the tank

[18] Miguel Feijóo de Sosa: Relacion descriptiva de la ciudad, y provincia de Truxillo del Peru, con noticias exactas de su estado político, Madrid, 1763.

FIG. 34—Examples of the art of the Chimu potters, showing their extraordinary skill in depicting facial expression.

floors—practically the only plant life still to be found in the ruins. One measures 600 yards in length by 50 in width, and another approximately 500 feet in length by 195 in width and 60 in depth.[19]

Outside of the Chan-Chan area and east by north of Trujillo was one of the principal reservoirs.[20] Wiener presents a plan in detail of the aqueducts about the site of Chan-Chan, but one gathers from his description and plan that only the principal aqueducts can be seen today and the smaller distributaries are to be inferred. In any case, the large reservoir now called "La Manpuesteria" was fed by

FIG. 35—Examples of Chimu copper work. From left to right: man rowing a *balsa;* two monkeys, one carrying a basket on his back, the other in act of throwing a ball; ball with four monkey-like animals climbing up sides, probably tied to a thong and used as a weapon; man adjusting pack on his back; man carrying olla and blowing conch, and hunter carrying a deer. (From the Holstein collection at the American Museum of Natural History, New York.)

[19] Squier, *op. cit.*, p. 155, gives the dimensions of one as 450 feet long by 195 feet wide by 60 feet deep and says that there are a hundred others of larger or smaller size.

[20] It is shown upon Hrdlička's map, Anthropological Work in Peru, p. 47, and in Wiener, *op. cit.*, p. 98; but the latter has a wrong orientation upon his map, east being given as north.

the river Moche. By means of this and other reservoirs the plain about Chan-Chan was irrigated and the city reservoirs kept filled for the needs of a great population even when the river Moche was at low-water stages or when the season was particularly dry. Clearly

FIG. 36—Ruins of fort in the Virú valley.

such elaborate works can only mean a population so large as to put to the test their utmost skill in finding the necessary water supply.

That these people were skillful artisans in gold, silver, copper, wood, and clay is attested by the fact already mentioned that wonderful specimens have been taken from the ruins in past years and are still occasionally found. No one can examine the accompanying photographs or the published illustrations of Chimu art[21] without experiencing great surprise first at the quite remarkable realistic quality of the pottery, the wide range of representation calling for an equally wide range of technical skill and artistic expression. They showed great skill in depicting facial expressions, and every human emotion from agony to mirth is registered in this form. In a relatively short time a people of unusual capacity and intelligence was able to take care of the material side of life, construct great engineering works, build massive and time-defying monuments, and with it all develop

[21] As given, for instance, in Middendorf, *op. cit.*, Vol. 2, pp. 390, 391, 393, in Kroeber's reproduction of figures from the Uhle collection, or in the superbly illustrated volume by Walter Lehmann and Heinrich Doering: Kunstgeschichte des alten Peru, Berlin, 1924.

an effective and powerful political and social organization that reached its cultural climax in a very high level of specialized forms of art.

The ruins of Chan-Chan are today in a very poor state of preservation, in part by the ruthlessness of treasure hunters who have plied their tools without regard for the scientific interests the ruins hold. Seismic disturbances and meteorological phenomena, which have occurred at intervals, have also done their share of destruction. An earthquake on February 14, 1619, razed every house in Trujillo within the space of one minute; another on January 6, 1725, was but slightly less severe; in 1739 a third one occurred. Paz Soldan states that the great earthquake of 1687 made vast tracts sterile.[22] Feijóo de Sosa reports similar soil effects at Lima. Owing to the apparent flexibility of the material and the construction of the walls, Chan-Chan seems to have suffered less from earthquakes than from the rains which appear to occur in cycles at considerable intervals. The rains of 1701, 1720, and 1891 must have done great damage to the ruins,[23] judging by effects observable from the rains of March, 1925.

[22] Mateo Paz Soldan: Geografía del Perú, Vol. 1, Paris, 1862, p. 212.

[23] Feijóo de Sosa mentions the rains of 1720, 1728, and 1747 as especially noteworthy.

THE CAMINO DEL DIABLO: WITH NOTES ON A JOURNEY IN 1925

Godfrey Sykes

Desert Laboratory, Tucson, Arizona

THE road from Ajo to Yuma by the Camino del Diablo ("devil's road") is probably the most difficult and dangerous route in the Papago country. The region west of the Growler Mountains, east of the bluffs of Colorado River, and south of the Southern Pacific Railroad, an area 60 miles wide on the east and 20 miles wide on the west and nearly 100 miles long, has only one permanent inhabitant, who is the caretaker at the Fortuna mine.[1]

The Camino del Diablo follows quite closely the United States-Mexican border (see Fig. 1). The above quotation describes the northern part of the region through which it runs: the southern, or Mexican, part is drier and if possible less inhabited over a vast extent.

Early Travelers

The first recorded journey over this famous road was made early in the year 1699 by Father Eusabius Kino, the pioneer missionary amongst the various Indian tribes of Pimeria Alta and Papagueria—today southern Arizona and northern Sonora. Accompanied by Commander Juan Matheo Mange, Father Adamo Gilig, and a numerous retinue of servants, Indian guides, and camp followers, together with some ninety head of pack and riding animals, Father Kino left the outlying Spanish settlements on the Magdalena River on an expedition to the distant Indian tribes along the lower Gila.

It is difficult to identify the exact course taken, even with a thorough knowledge of the region and the help afforded by the map and diary of Kino and the journal of Mange, but there is little doubt that it approximated pretty closely to the route followed by Kino upon several subsequent occasions, which in part developed into and gained unenviable notoriety a hundred and fifty years later as the dreaded Camino del Diablo.

The Kino-Mange party made their journey in midwinter, and, as they had been delayed by heavy rains before leaving the Spanish settlements, the season was undoubtedly a favorable one for crossing the desert. They traveled, under Indian guidance, first towards the north to Tubutama and Saric, then almost due west until they

[1] Kirk Bryan: The Papago Country, Arizona: A Geographic, Geologic, and Hydrologic Reconnaissance with a Guide to Desert Watering Places. *U. S. Geol. Survey Water-Supply Paper 499*. Washington, 1925. p. 413.

dropped into the drainage of the Rio Papago, or Sonoita River. The little Indian settlement of Sonoita, which has survived as the small Mexican hamlet of the same name, was then, as it remains today, the last focus of human activity towards the northwest. Indian guides for the desert were secured at this place, water was obtained at the associated watering place of Carrizal, and the fifty-three leagues

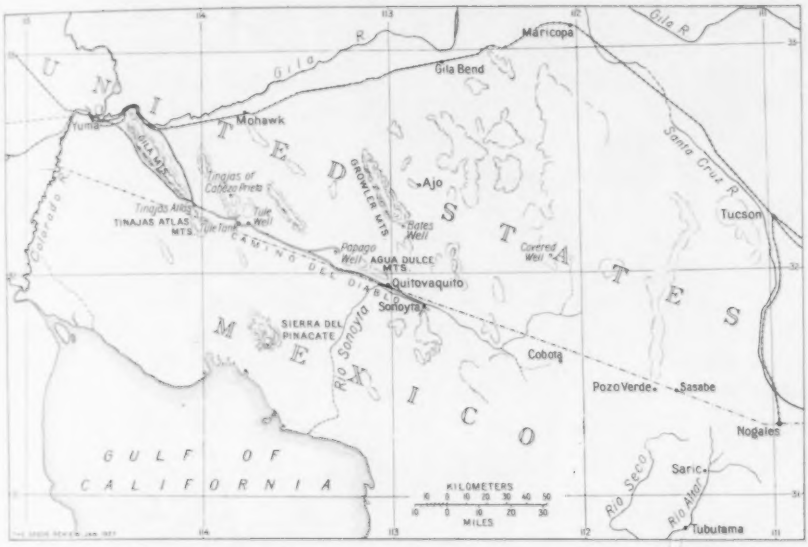

FIG. 1—Sketch map of southwestern Arizona and northwestern Sonora showing the location of the Camino del Diablo. Scale 1:3,600,000.

which remained between there and the Gila were safely traversed in five days.

The route forms a chord to the great arc made by the upper Altar, Santa Cruz, and Gila valleys; which was otherwise the logical route to have followed, inasmuch as water and forage for their animals would have been pretty well assured. The saving in distance was a very substantial one, however, the total mileage being some two hundred and thirty as against nearly four hundred for the longer but safer way.

There is no record available of any further use of the desert route by white travelers for many years after Kino's time; but, as Spain began to develop possessions and interests in California Alta in the last quarter of the eighteenth century, it again became a recognized line of communication between the Sonoran settlements and the western coast and began to take its heavy toll of human and animal life.

Father Garces traveled from the Magdalena settlements to the mouth of the Gila in 1772 by way of the desert and acted as unofficial guide for the expedition of Commander Juan Bautista de Anza over the same route in January, 1774. By this time the name, Camino

del Diablo, seems to have been established and applied to the particularly hazardous hundred and fifty miles which must be traversed between Sonoita and the Gila.

Between these two points water can be found, and then in very limited quantity, at only two places, with the added possibility after heavy rainfall of a further scanty but evanescent supply at one other spot. The two more-or-less assured natural supplies are in *tinajas*, natural eroded basins in the rocky mountain sides, which serve as concentration points and catchment basins for rain water. The occasional supply is in a series of *charcos*, shallow pools, where the soil is sufficiently impervious to retain water until it is dried up by evaporation. Forage of any description is scant except for brief periods after the infrequent rains and even then is poor and unsustaining in quality.

Even to the seasoned and reasonably well-equipped desert traveler such a journey involves some serious risk, especially during the hotter months of the year, through the possible breakdown of equipment, loss or exhaustion of stock, or failure to find a supply of water at known watering places; while for those whose equipment or strength does not reach a certain rather definite standard, disaster is almost certain.

Later Use of the Road

It was during the period of the first great overland rush to California, beginning in 1849 and lasting through the early fifties, that travel along the Camino del Diablo reached its maximum and the loss of life became most appalling. Parties were hurriedly and inadequately organized and equipped at various points along the Texas frontier and did not realize the danger they were involved in until the small Sonoran settlements were left behind and the desert was actually surrounding them.

Various estimates have been made as to the deaths from thirst and other mischance between Sonoita and the Colorado during these few years of wild excitement; some placing the numbers at hundreds, others at thousands. The facts can never be known, but it is significant that over fifty rude graves can be counted still in one small area at the foot of the rocky chine which contains the Tinajas Altas. Numerous others can be identified along the route, in spite of the obliteration due to time, wind, and occasional torrential rains, and of the probability that the actual line of travel was several miles in width except at certain focal points such as the tinajas.

Placer gold was discovered at various places in the Colorado valley just before 1860, and another wave of excited gold seekers began to pass over the desert to reach the new camps. These travelers were mostly Mexicans from Sonora and other near-by Mexican

FIG. 2

FIG. 3

FIG. 2—Papago Well. The deep borehole is under the headframe, the sand pump can be seen suspended above the well casing.

FIG. 3—Tule Well. The desert guidepost in the background.

states. The loss of life was again very heavy, and in a few years the road was almost abandoned, even by these native Sonorans, as being too dangerous. The alternative route along the Gila was commonly used before the mid-sixties.

The region has remained entirely undeveloped and practically unknown from that day to this, save for an occasional mining prospect in some of the surrounding mountain ranges. The old road itself is but seldom traveled, although two wells in which water can always be obtained now exist, one at either end of the most dreaded stretch.

The International Boundary Commission, which surveyed and remarked the boundary line between the years 1891 and 1896, examined the border strip, which includes a large portion of the old Camino, quite thoroughly in the course of their work, and the description of it given in the official report merits quotation:

> During the "early sixties" there was a large influx of Mexicans from Sonora to the gold diggings on the Colorado River, and an enterprising Mexican dug two wells near the road, in the Tule Mountains, built a small adobe house, and occupied it with his family for two years, for the purpose of selling water to travelers. But the deaths from thirst along this route became so frequent that the road was soon abandoned, and for over twenty years had remained unused. Having accidentally learned of the former existence of these old wells, which are not shown on any maps, arrangements were made to have them cleaned out as soon as possible. This was done by a party of Mexicans and Papagos from Sonoyta, who found them almost filled up.
>
> These important wells are situated on the road about 5 miles north of the point where the line crosses the summit of the Sierra del Tule, and when thoroughly cleaned out yield a supply of about 500 gallons per day. The water is beautifully clear, but owing to the presence of minerals has a vile taste and is very unwholesome. Near the wells stand the ruins of the old adobe house, the only building between Quitobaquita and the Colorado River.[2]

At the present time only one of these two wells is in repair. It is maintained as a desert watering place by Yuma County and has one of the excellent signposts established by the United States Geological Survey placed close to it. The report continues:

> The road between Agua Dulce and Yuma is for the most part very heavy, and, until the Tule Wells were reopened, no certain supply of water could be counted on between Agua Dulce and the Colorado River. This road is appropriately called by the Mexicans "El camino del Diablo." When traveling it for the first time, alone or with but few companions, it is hard to imagine a more desolate or depressing ride. Mile after mile the journey stretches through this land of "silence, solitude, and sunshine," with little to distract the eye from the awful surrounding dreariness and desolation except the bleaching skeletons of horses and the painfully frequent crosses which mark the graves of those who perished of thirst—grim and suggestive reminders when the traveler's supply of water is running low. In a single day's ride sixty-five of these graves were counted by the roadside, one containing an entire family, whose horses gave out and who, unable to cross the scorching desert on foot, all perished

[2] Report of the Boundary Commission upon the Survey and Re-marking of the Boundary Between the United States and Mexico West of the Rio Grande, 1891 to 1896, Washington, 1898, Part II, pp. 24–25.

FIG. 4

FIG. 5

FIG. 4—Vegetation amongst rocks at Tule Tanks (principally *Elaphrium microphyllum*).
FIG. 5—A roadside grave on the Camino del Diablo.

together of thirst. Their bodies were found by some travelers during the following rainy season, and were all buried in one grave, which is covered with a cross of stones and surrounded with a large circle of stones, inside of which not a bush nor a blade of grass grows. Near by lie the skeletons of their horses and the broken fragments of their water bottles.

During the few years that this road was much traveled, over 400 persons were said to have perished of thirst between Sonoyta and Yuma, a record probably without a parallel in North America.[3]

The other well now existing on the old Camino is a deep bore known as the Papago Well, and this is also marked by a desert signboard. Obtaining water from it is a rather laborious process, the only means of raising it being a sand "pump," which is lowered into the bore by a winch and steel cable.

Since the development of motor transportation a few travelers use the route each year. As it follows the border closely, border line-riders are at least supposed to pass along it occasionally, although it would be well for intending desert wayfarers not to rely too much upon their presence and assistance at any given time.

For the driver of a car, the question of water has ceased to be the most serious one in desert traveling. Sand, rough surface, and cross-washes are likely to prove much more formidable; and of course the danger of breakdown when far from possible help is always to be reckoned with. It is these matters that make a journey undertaken and successfully accomplished by the late Raphael Pumpelly and some members of his family over the Camino, in the spring of 1915, the more notable. In striking contrast were the conditions of his earlier journey along the road in 1861. That journey also was successful although made in July; but his party was fortunate enough to encounter a heavy rain while crossing the Tule Desert.

Lumholtz traversed portions of the route in 1910, when engaged upon his examination of northwestern Sonora, and visited and camped at both Tule Tanks and the Tinajas Altas. He was, of course, fully prepared to encounter any ordinary desert conditions and traveled with Indian and Mexican assistants who knew something of the country. His work in this region was accomplished in winter and early spring, when the heat is not a serious factor.

An Example of Desert Thirst

During the summer of 1905 the late Professor McGee camped in quite primitive fashion at the Tinajas Altas for more than three months, gathering meteorological and other data. He records a remarkable case of what he describes as "desert thirst." A Mexican prospector, 40 years old, well versed in the ways of the desert and exceptionally strong and robust, was out on the desert to the south

[3] *Ibid.*, Part II, p. 26.

FIG. 6

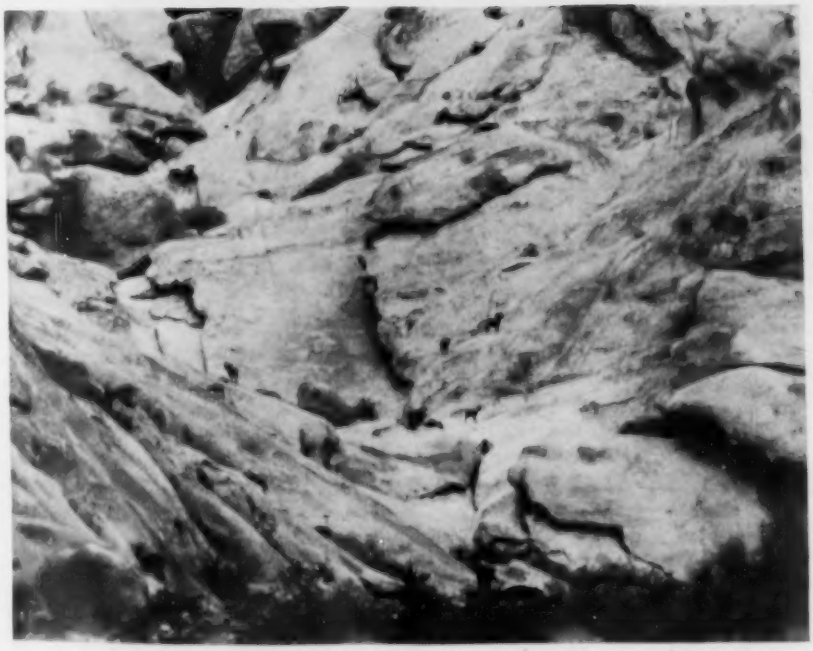

FIG. 7

FIG. 6—A general view of the Tinajas Altas (see also Figure 8).

FIG. 7—Telephotographic view of the Tinajas Altas from a distance of half a mile. A number of mountain sheep (*Ovis Nelsoni*) can be seen on the rocks.

of the Camino for a period of nearly eight days with a supply of water not more than sufficient for two days, and yet he succeeded at length in crawling back to McGee's camp at the Tinajas. Dr. McGee and his Indian helper, aroused by a hoarse, rasping, bellow, quite unlike

FIG. 8—The Tinajas Altas (see Figure 6). Looking down the chain of *tinajas*. This view was taken from the top of the chine, with the camera pointed downward at an angle of about 35°.

a human voice, ran down the trail: "and on the arroyo sands, under an ironwood tree, at the foot of the Mesita de los Muertos with its two-score cross-marked graves, came on the wreck of Pablo."

> He was stark naked: his formerly full-muscled legs and arms were shrunken and scrawny; his ribs ridged out like those of a starveling horse; . . . his lips had disappeared as if amputated, leaving low edges of blackened tissue; . . . his eyes were set in a winkless stare, with surrounding skin so contracted as to expose the conjunctiva; . . . his face was dark as a negro, and his skin generally turned a ghastly purplish yet ashen gray . . . his lower legs and feet, with forearms and hands, were torn and scratched by contact with thorns and sharp rocks . . . yet without trace of blood or serum.[4]

In spite of his serious condition Dr. McGee succeeded, after several days, in restoring him to a condition in which he began gradually to regain his strength and weight; although the ordeal through which he had passed had thinned and whitened his hair, and he remained dazed and uncertain in speech and memory for some little time afterwards.

Dr. McGee states, with emphasis, that the mental habit of the

[4] W J McGee: Desert Thirst As Disease, *Interstate Medical Journ.*, Vol. 13, 1906, pp. 279–300; reference on p. 283.

man was all important, and I fully agree with him upon this point. My own experience in nearly forty years of desert work and travel has taught me the same thing. Two men of nearly equal physique and strength may be lost or forced to endure prolonged exposure in the desert under almost identical conditions. The nervous and excited man will die, while the phlegmatic or "nerveless" one will survive. The ability to endure and accomplish heavy physical labor under prolonged high temperature seems to be largely a racial matter. The Mexican, especially if his veins contain some Indian blood, can commonly withstand heat, if accompanied by low humidity, that causes distress to the average negro and almost total inability to undergo sustained exertion to the average Anglo-Saxon. In the particular instance described by Dr. McGee, furthermore, the weather was unusually favorable, the sky being overcast and the temperature comparatively low for the whole period.

The Author's Experiences

Circumstances occasionally arise, in a region such as the one under discussion, which show what the combination of high temperature and heavy physical exertion—even though unaccompanied by any great shortage of water—may mean even to those who are fully inured to the desert.

The early months of 1925 were extremely dry in southwestern Arizona, and July temperatures were rather above normal. The winter of 1924–1925 had passed almost entirely without rainfall, and in fact the whole of 1924 had also been exceptionally dry. In these circumstances an examination of the vegetation and desert water holes appeared to be advisable before the beginning of the expected summer rains. I started alone from Tucson in a heavy touring car on July 22 to visit several of the desert tanks, Tule Tanks and the Tinajas Altas amongst the number, and to make a general examination of the desert along the line of the old Camino. Ajo was passed the same afternoon, and I then struck south for the Mexican border. The temperature in and about Ajo was quite reasonable for the season, being but little over 100° F.; but the following day, on getting into the Tule Desert, I found temperatures averaging 115° in the shade of the car.

The road is but seldom traveled nowadays, although an excellent log of the portion of it lying on the United States side of the border is to be found in Water Supply Paper 449.[5] Upon approaching the northern end of the Pinacate lava field, which is flanked along each edge with belts of sand described by the compilers of the log as the most difficult parts of the road, I found that recent heavy winds from the south had not only obliterated almost all traces of the road but

[5] See footnote 1.

had produced a series of drifts and windrows of sand. Several hours of heavy labor at shoveling, cutting and laying brush in the track, and deflating and re-pumping tires were necessary before these troublesome stretches could be crossed. On this occasion the car was not equipped with any special devices for crossing sand.

This seemed a favorable opportunity for observing the combined effect on the human organism of heat, violent physical exertion, and the sparing use of water.

I think that it may be reasonably assumed that the question of environment and remoteness from any possibility of assistance did not seriously affect the situation, for it has been my habit for many years to make journeys of this description alone and often under similar conditions. I began the work about midday, with the temperature hovering around 115° at the start and gradually falling to 110° when I at last got clear of the sand at 4.15 p. m. The temperature of the water in my canteens remained at about 95°, and the water was used principally to rinse my mouth with; this is the habit of most Mexicans when at work in the hot sunshine. They drink only when resting or eating.

My pulse ranged from 78, which is about normal for a man of 64 at that temperature, to over 145, after a particularly strenuous half hour. It was not possible to take any reliable body temperatures, owing to the difficulty of working the mercury column down in the thermometer and also on account of the heated air which I was breathing. Twice during the early afternoon I approached the danger point that is almost universally recognized amongst desert workers—the sudden checking of perspiration. If this condition is not quickly remedied it is followed by collapse; but I was able in both instances to avert the danger by stretching myself out for a few minutes in the shade of the car.

I encountered more heavy sand later in the evening and also on the following morning, when working across country to visit and examine tanks in some of the surrounding mountains. This involved a good deal of deflating and re-pumping of tires although not much digging. Upon reaching the Tinajas Altas I climbed to the top of the mountain to inspect the higher tanks and again found a shade temperature of 108° at noon, with every indication of an increase. The Tinajas were almost dry—only two of the nine holes containing any water at all and these only some few gallons.

The net physical result of this journey was a temporary loss of fourteen pounds in weight, from 168 to 154, and some slight digestive trouble due, as I think, to eating some very doubtful canned food.

I again essayed the journey alone over the old road later in the summer, after some particularly heavy and torrential storms. Upon this occasion, however, my car was equipped with "sand treads" for

FIG. 9

FIG. 10

FIGS. 9 and 10—Country through which the Camino del Diablo passes. Figure 9 is a view of Cabreza Prieta, north of the road. Figure 10 is the Pinacate lava plain to the south.

the wheels, which made deflation unnecessary. Roads were badly washed throughout the region, and some little digging was needed here and there in order to cross gullies and small washes. No other vehicle had passed along the road in either direction since my earlier trip; but, although the sand was soft in some places, the late rains had made it much more passable. The trouble now was to distinguish the road. The temperature was down into the nineties and hence quite tolerable.

Road conditions became steadily worse as I approached Tule Tanks, and I was obliged to shovel out several passages through deep arroyos. At last a point was reached from which the Tinajas Altas could be plainly seen across the intervening desert, but all traces of road had disappeared; and a reconnaissance on foot, extending over a radius of about three miles, at length convinced me that fully two days of single-handed digging and rock moving would be necessary before I could get clear of this plexus of trouble. I therefore reluctantly made my way back to Papago Well and then turned northward across some exceedingly sandy country to the little settlement of Mohawk on the Southern Pacific Railroad.

As a postscript I may add that a party of prospectors or other interested wayfarers succeeded in opening up the road a few months after this journey, and a little later my son also drove a car through with one companion. I have myself followed the greater portion of the old road twice in the last summer during my periodical inspection of the seasonal rain gauges that I have in commission in the region.

THE NEW PALESTINE

Andrée Choveaux

A PEOPLE is in movement. The Jewish people, wanderers for centuries and scattered all over the earth, are gathering anew on the land of Israel. It would seem that the longing, never lost, for the country of their ancestors is about to be satisfied. It is the culmination of several tentative efforts in recent years to resurrect the ancient kingdom of David. Especially is the development of Zionism associated with the Austrian Jew, Theodore Herzl, who headed the movement thirty years ago. But the realization of the Zionist dream involved so many social, financial, and political problems that its visionary nature was only too apparent. It was scarcely conceivable that Abdul Hamid, Commander of the Faithful, would relinquish Jerusalem with its mosque of Omar, next to Mecca and Medina the most sacred place of the Moslem world; or that the Christian nations would comtemplate with favorable eye a Jewish guard around the Holy Sepulcher. How would the Russian government accept a Jewish triumph in Palestine, reinforcing the power and pride of the Jews that remained on their territory? And how could the Jews of France, Germany, England, and America, sincerely attached to the countries of their adoption, be committed to the reclaiming of a new country?[1]

Jewish Immigration into Palestine

How then has the unforeseen revolution in world affairs created by the World War thus miraculously transformed the dream into a reality? As the report of the High Commissioner for Palestine[2] puts it, "the fact that has dominated the situation" has been the Balfour Declaration made by the Foreign Office on November 2, 1917, and endorsed by several of the allied governments.

> His Majesty's Government view with favour the establishment in Palestine of a National Home for the Jewish people, and will use their best endeavours to facilitate the achievement of this object, it being clearly understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine or the rights and political status enjoyed by Jews in any other country.

The Declaration, reaffirmed at the San Remo Conference in 1920, was subsequently embodied in the mandate for Palestine approved by

[1] Jérome and Jean Tharaud: L'an prochain à Jérusalem!, Paris, 1924, p. 103.

[2] Palestine: Report of the High Commissioner on the Administration of Palestine, 1920–1925. Colonial No. 15, London, 1925.

the Council of the League of Nations in 1922[3] and endorsed by the United States.[4]

The Jews had gained a country, and from Germany, Rumania, Poland, and Russia they issued forth in their thousands to the "reconquest" of their promised land.

From the British occupation (1917) up to March 31, 1926, Jewish immigrants to the estimated number of 83,000 entered Palestine. For the year 1923 the number was 7421; for 1924, 12,856; for 1925, 33,801.[5] The total number of Jewish settlements at the end of 1925 was 100, and the area of Jewish holdings of land in Palestine 1,100,000 dunam, or about 250,000 acres. These figures in themselves explain all "Erez Israel"—the official Hebrew expression for the commencement of the reconstruction of Israel. Along the roads and railways blossom unexpected patches of scattered settlement. Here are new houses of European aspect, with red roofs and blue window shutters, entirely unlike the native huts, stone cubes scarcely distinguishable from the mountain slopes on which they stand. Close ranks of white tents shelter indefatigable workers, these fervent "Haluzim," men and women who, pick and mattock in hand, make a road, a house, a field, a country. This town, born yesterday and growing without pause, is a living symbol of their febrile activity. New and curious sights these are in the Holy Land, as surprising as the long forgotten sonorities of the old Biblical tongue, awakened from the dead and living, flourishing amazingly in school, shops, and streets.

Such happenings in a land of ancient and eventful past create a human problem of great magnitude. It is well to ask how this movement is being realized under our eyes: what are the means by which it is being accomplished, what its elements and its resources for the future?

But first, what is Palestine? The Biblical land of abundance, overflowing with milk and honey, today presents itself in harsh and arid guise: the trench of the Jordan, floored with sand and sun-baked mud left by the retreating waters of the Dead Sea, an unnatural sea hostile to life; the long mountain ridge from Judea to Lebanon, barren summits, livid and mournful, treeless, the terraces of former cultivation long since crumbled, only an olive here and there clinging by a miracle to the loose stones of the limestone slopes; only in the ravine bottoms a little soil to support precariously the luckless Judean shepherds and their meager flocks of little black sheep; the coastal plain where sand replaces rock and under a devouring sun becomes desert where water is lacking or elsewhere is transformed into unhealth-

[3] Council of the League of Nations, done at London the 24th day of July, 1922.

[4] American endorsement. Resolution unanimously passed by the House of Representatives on June 30, 1922.

[5] Exclusive of 5000 returning war refugees. Also exclusive of this figure the total net immigration is estimated at 71,000. Memorandum submitted to the Secretary-General of the League of Nations for the information of the Permanent Mandates Commission, October, 1925. The text of the Memorandum is printed in the *New Judea* (London, June 11, 1926.)

ful marshes. Only the valleys (Jezreel or Esdraelon) are green and rich, the irrigated regions (plain of Sharon) and the banks of the Sea of Galilee, picturesque and smiling.

Zionist colonization, according to the plan which has been in operation since about 1920,[6] has penetrated chiefly in the following regions: Jaffa and its environs in the fertile plain of Sharon, designed as a base for further spread and as a focus of relations with the West; the northern coastal plain; northern Samaria and Galilee (the plain of Esdraelon and the valley of the Jordan) with the greatest "possibilities"; and the nucleus, Jerusalem, more important for its situation and spiritual significance than for its resources.

The whole can be described as a triangle, the "Zionist triangle." "On the coastal plain the industrial town, the port of commerce. This is Tel Aviv, strong materially. In the plain of Esdraelon the harvests of corn and social justice: this is the Emek, strong in brotherhood. At the summit of Judea, inhuman but burning with spirituality, the house of the soul."[7]

Tel Aviv, the Industrial Settlement

Tel Aviv, "Hill of Spring", is the precious jewel, the gem most brilliant by size and luster in the Zionist diadem. Its mayor describes his city as the "most progressive in the world," and in fact it is so very young that it does not yet appear on the standard atlases and the excellent English war maps and post-war maps which are not Zionist documents. By the side of Jaffa, the old headland city, picturesque and dirty, Tel Aviv has sprung up in a few years. In 1909 here were only sand dunes along a low and narrow coast, a splendid beach where the sun shone on rolling, surf-bound blue waters, a desert no less than the vast sandy stretches from El Arish to Gaza.

It was here that the nascent Zionism laid, timidly enough, the first stone of the first Jewish town of the new Palestine. The first houses were built in 1910–1911. The population numbered a bare 900 in 1913, and there was little increase until 1920 when a great effort was put forth. In 1920 the number rose to 10,000; in 1924, to 25,000; in 1925, to nearly 35,000. In 1921 the town covered 3700 acres, in 1924, 8600. In 1925 there were 3000 houses, and, as it is said, "three are finished each day that God gives." It suggests an immense building yard where under a burning sun endless convoys of camels carry limestone blocks of a dazzling whiteness. Everywhere dust, plaster, sand, cries, grinding of saws, hammer blows, a feverish and startling activity in the accustomed somnolence of the East.

Tel Aviv is entirely independent of Jaffa. It has a municipality, an administration, and an autonomous police of its own. Under the

[6] Data obtained from Tel Aviv, Jewish Agency, April, 1925.
[7] Jean Richard Bloch: La Nouvelle Sion—Intransigeant, Paris, May 20, 1925.

FIG. 1—General view of Tel Aviv from Jaffa. (Photograph by Eliahu Bros., Jaffa.)

direction of its mayor, a distinguished student of civics and a former pupil in a French university (Montpellier), its prodigious building boom is strictly directed and regulated. "The Hill of Spring"—the name is purely symbolic, for the region is absolutely flat and spring is short and hot—far from becoming the architectural Babel that its first buildings, 1910–1920, would seem to forecast, today presents the aspect of a modern city: straight streets and long, tree-bordered avenues that divide into almost regular blocks the several quarters each with its own characteristics and regulations. In the residential quarter, Nice or Palestinian Vichy, each cottage is embowered in a garden. One-third of the area only has been built upon; no houses front on streets: it is a garden city. On the sea front are the hotels, the pensions, hospitals, playgrounds, even a casino. Towards Jaffa is the quarter given over to light industry where the domestic trades (manufactures of hats, clothing, shoes) find inexpensive accommodations in the great municipal buildings, well lighted and ventilated workrooms with water, electricity, and often power from compressed air. In these more crowded quarters where greenery is rarer, though not absent, the atmosphere is scientifically disinfected by the municipality during the evening. The two main thoroughfares—crossroads, one leading to Jaffa, the other to the sea—constitute the business section of attractive and flourishing shops. Innumerable signboards, varied and picturesque in design, swing over the streets, reminiscent of the ghetto. There are many book shops (I counted seven large and three small ones in one street) and music shops. There are elegant hairdressing establishments: in contrast not a saloon. It has been remarked that "it is easier to buy a book or magazine than a drink";

FIG. 2—A street in Tel Aviv. (Photograph by Eliahu Bros., Jaffa.)

it might be added "if one speaks Yiddish or German." Arabic, English, and French, constantly used throughout Palestine and in near-by Jaffa, have no place in the new Zion.

The mushroom town, now stretching over a space of five kilometers, soon to be seven, already has suburbs where the roads run towards the sea to the north and east—Nordia and Borüchov; and the heavy industries are generally localized in these quarters far from the center of the city. No less than 130 factories, mostly spinning mills of Austrian origin, are in full swing, and other large plants have more lately been established. An important tannery has been installed at a cost of £40,000; silk mills, chiefly intended for making crêpe de Chine, have come from Vienna; brickyards, furniture factories, a chocolate factory, and a large silicate plant (The Palestine Silicate Company, capital £75,000) each employing several hundred workers, have grown out of actual needs of construction.

All these establishments are run by electricity and on the most modern lines. Light and power have for some time been furnished Tel Aviv and Jaffa from the powerful transforming station of the Palestine Electric Corporation (capital £400,000), the first Zionist industrial organization authorized by the English government. This station is installed some little distance away on the streamlet Auja, which also furnishes water to the city.[8]

In the town the central electric station (1200 kilowatt power) is a building of pure Jewish architecture. So also is the lyceum, the most prominent building, begun in 1909 and today accommodating

[8] Under the energetic director of the organization, P. Rutenberg, similar works have more recently been undertaken in the Haifa section.

600 pupils. A railway was opened in 1921: it runs only to Jaffa, however, and adds but little to the already numerous means of communication by autobus and horse trams between Tel Aviv and its nearest neighbor.

The "Hill of Spring" earnestly supports education. There are 22 primary or upper primary schools, 6 special technical schools, 3 music schools, and 13 kindergartens, while there are 8 daily papers published in Hebrew. Hospitals and dispensaries jealously guard the health of the citizens. Pride is even taken in the municipal watering carts, for sprinkled streets are a highly appreciated luxury in this realm of sand and dust.

The rapidly growing town counts—and perhaps this explains its growth—an important majority of workingmen, 32 per cent of the population gainfully employed; then come traders, 31 per cent; municipal employees and functionaries, 24 per cent; teachers, 3 per cent; the liberal professions—doctors, lawyers, and, most numerous, architects—10 per cent.

It is a striking thing, however, that the marvelous orange groves occupying a belt 6 kilometers broad round Jaffa are mostly in Christian hands and do not offer employment to the Jewish population. Furthermore, such Jewish proprietors as exist will employ their fellow religionists only under compulsion. They much prefer the Arabs, who work longer and for less money; wages at Tel Aviv are high because artificially stimulated.

Outside of construction works and the manufactories the only opening for the inhabitants of Tel Aviv is trade, and even here there are difficulties. It is not practicable to establish a port by the side of Jaffa, whose own existence is precarious enough. The coast is difficult of access—because of rocks and bar and surf ships cannot approach the harbor, and goods have to be lightered—and an economic hinterland is lacking.

But the "Hill of Spring" advertises itself as the hope of Jewish trade. Already many of the shops of Jaffa (40,000 people) have been deserted for the more attractive and better stocked shops of the Jewish city. There it appears is the future of Tel Aviv. The mayor's dream is to have 100,000 inhabitants in ten years or, better, in five years and to become in the future the metropolis of Asia Minor. A somewhat ambitious dream; but it is a fine thing to have already created, in such a situation and under such conditions, so beautiful and prosperous a city.

The Agricultural Colonies: In the Maritime Plain

Not all the colonies of the Jaffa group have enjoyed the vigorous growth and success of the "Hill of Spring." Forty years ago in this

FIG. 3—The Jewish colonies in Palestine from maps of the Keren Hayesod and the Keren Kayemeth. Scale of map 1:1,150,000.

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same region Russian Jews, fleeing the pogroms, founded the first colonies. Their beginnings were difficult.[9] To the north Pethah-Tikva, "Door of Hope," was planted on marshy and unhealthful ground; to the south Rishon-le-Zion, "First in Zion," on stony and waterless land. These unhappy "Lovers of Zion," as they named themselves, trusting too much in the Biblical traditions of the land, decimated by fever and destitute of resources, could not have held out but for the beneficent help of Baron Edmond de Rothschild. By his financial aid sandy soil has been irrigated, marshes drained, wells dug, trees and vines planted, houses built, taxes paid.[10] Thus the verdant gardens of olive and eucalyptus are accounted for, the vineyards, the orange and citron groves, the indispensable reservoirs, veritable "chateaux d'eau," diffusing life and marking the flourishing colonies of today.

The "Door of Hope" now opens on a garden of more than 3700 acres of delicious fruited orange trees. Many thousands of Jews live on it, though it is far from comparable with the famous groves of Jaffa. Near by are Kfar Saba and Ein Ganim and, overlooking the road and rail to Jaffa, Mikveh-Israel with its important agricultural school. The 750 hectares of Rishon-le-Zion have become a single vineyard whose product has acquired renown for its quality and made good its name as a first fruit of Jewish endeavor. It has an important export trade. Neighboring groups, as soon as they obtained water, have also planted the vine on these foothills of mountainous Judea: Ben-Jacob-Rekhovoth, "Whom God Increaseth," stony but sunny, where the eucalyptus, whose wood is much in demand for orange boxes, has conquered the low sandy stretches. At Ekron the red roofs, seen from the Jerusalem-Lydda train, are lost in fruit trees, almond and olive. Other little groups are strewn along the sandy road from Lydda to Gaza—Gedera, Beer-Tovia; and along the mountain road from Lydda to Jerusalem—Gezer, Khulda, Ben-Shemen.

That determination to conquer the wilderness the Zionist pioneers also brought to bear on the seaboard of Samaria, marshy and malarious. The cost was high: many memorial stones scattered about the fields recall the names of those who perished in the struggle, but the work of drainage has been accomplished in part, and many eucalyptus plantations are improving the salubriousness of the country. There is Zichron Jacob, "Souvenir of Jacob," at the foot of Mt. Carmel, in memory of Edmond de Rothschild and his father, who supported it; respectively west and east of the Haifa railroad are Khedera and Kerkur, and to the north Bath-Shlomo, maintaining at great pains

[9] Pierre Mille: Colonies juives et allemandes en Palestine, *Ann. de Géogr.*, Vol. 8, 1899, pp. 160–169.
The history of the colonies and their present status is discussed in A. J. Brawer: Il ripopolamento della Palestina con gli Ebrei, *L'Universo*, Vol. 7, 1926, pp. 533–565.

[10] Jérome and Jean Tharaud: *op. cit.*, pp. 142–145.

the eucalyptus, olives, and vines which are their *raison d'être* if not their entire support.

Colonies of the Emek

From Haifa there runs inland thirty miles or more to the southwest the plain of Esdraelon and the vale of Jezreel. This is the Emek, the plain traditionally famous for its crop and its flowers, whose praises have been sung from David to Renan and Loti. In fact it is a narrow passageway, terribly hot, humid, and unhealthful. The Arabs hold the heights, the Bedouins pasture their flocks thereon. Or so it was until 1920. Now it may truly be described as the "valley of realizations" with the most developed type of colony and an ideal organization of equality and justice "discarding the reigning forces of western civilization."

Each farmer is a tenant of Israel, the Jewish people being sole proprietor of the land; for the National Fund, supported by Jews all over the world, has bought bit by bit the sacred soil of their ancestors (35,000 acres in Emek). The land is allotted only on temporary title or lease. Each family cultivates as it pleases, by itself or grouped with others under coöperative or communal form. There the people have lived, happily and prosperously for the year or two since their arrival, without using any form of money. It is the Holy Land of collective work.[11] The great coöperative organization which, in principle, buys all the products of their communal industry furnishes according to need clothing, equipment, seed, foodstuffs. Naturally no colony is as yet self-supporting, and the dream of some groups of communists, as for example, Ain Harod near Balfouria, to be sufficient unto themselves, is unrealizable. Some scattered islets, it is true, are more or less fringed with verdure and yellowing harvests—wheat appears to do well in Emek—but they make all the more visible and heart-rending the desolation of the rest and recall at what a price these white houses, these cornfields, these rare olives and eucalypts have been brought into existence. Although aided by all the equipment and methods of modern agriculture, the first pioneers of Emek have had a terrible struggle. But nothing deters or discourages them in this mystic valley, the first land in the modern world to be cultivated and populated solely by Jews, the first wherein the laws of Zion can be realized.

From Haifa to the Jordan the settlements are strung along. Here is Kfar-Ezekiel, where 48,000 trees have been planted, a nucleus of bungalows, stables, and barns from which radiate in all directions some 60 little farms hidden among eucalypts, apricots, and orange groves. Gingar has planted 3000 trees. Nahalal is a swarming hive

[11] Jean Richard Bloch: *op. cit.*

amid 40,000 newly planted trees; Balfouria,[12] the "American colony," so named because all the agricultural implements were sent from America by the Union of Jewish Workers, stands proudly among its almond trees, an important group of pretty white houses with picturesque sloping roofs. Under its shadow is a newcomer, Benjamina. Merkhavya, "Place of God," includes some large farms.

The Jordan Valley and Jerusalem

From the Emek we pass to the Sea of Galilee, the beautiful lake whose blue waters, restless and sparkling, are dotted with the sun-bleached sails of the daring Galilean fishermen. It is easy to understand the seduction of this rich and smiling Tiberian region. For centuries the banks of the lake have supported a swarming mass of humanity, happy and prosperous. There are native Jews, Christians, Arabs; all the peoples who are represented in Palestine. Hence the newcomers who have succumbed to the charms of the region have been compelled to take what was left. There was little to choose from: the small Migdal, the old Magdala, founded in 1910 by the Russians and since augmented with new elements, some sparse groups about Tiberias, and lastly, at the south-southwest, Kinereth, stretching into the mountain since the banks of the lake are too narrow and too densely peopled to offer more accommodations. And inland from the lake lie Poria, Rama, Khitin, Sheyera on the road from Nazareth to Kfar Tabor; to the south of the lake is Dagania. East of the lake on the Trans-Jordan frontier is Bnei Yehuda. The apex of the Zionist triangle stretches along the upper Jordan to the frontier of Syria. Clinging to the mountain sides or seeking refuge in the valley are some dozen little colonies which it is hoped "God will enlarge": perhaps, one may add, if the physical conditions now none too good are improved. The "Keystone," Rosh Pina, between Safed and the Jordan, was founded by Russian and Rumanian Jews and, like Rishon-le-Zion and Zichron, saved by Edmond de Rothschild. Towards the north are Mishmar Hayarden, Ein Zeitun, Ayeleth-Hashakhar, and Yesod Hama'ala—the last on a small lake, Hule (the Waters of Merom), with marshy and inhospitable banks.

Lastly Metula and Tel Hai, the "Hill of Life" directly north, have been located for reasons more political than economic. They have suffered from the incursions of raiding Bedouins, and their colonists, mostly German, have undertaken vigorous reprisals. A legend even has sprung up around one of their number slain in 1919, a martyr to Zionism.

There remains the hardiest group—a group which does not fear to defy harsh Judea that it may find itself in the radius of Jerusalem.

[12] Myriam Harry: Les amants de Sion, Paris, 1923.

Most of these colonies are still under construction and have not yet realized what their destinies will be. The oldest, and the most remote also, on the road to Jaffa is Kiryath-'Anavim, "City of Vineyards," where a hundred colonists are in coöperative association; then Moza and Talpioth, "Hill of Beauty"; others are simply, as it were, ghettos surrounding the Holy City.

The Basis of Zionism

The accomplishment of such a result as this Jewish colonization of Palestine needs explanation: and the explanation is money. Money is in fact the basis and moving power of Zionism. More necessary than faith, it is money alone that has permitted this miracle, the transplantation of more or less poverty-stricken people on a land so inhospitable.[13] From 1919 up to March, 1924, there had been spent in Palestine for and by the Jews £7,000,000 sterling, and money continues to be spent.

Immediately after the recognition of the Palestine Mandate by the League of Nations the Jewish Agency was founded, whose creation was stipulated in Article 4.

> An appropriate Jewish agency shall be recognised as a public body for the purpose of advising and co-operating with the Administration of Palestine in such economic, social and other matters as may effect the establishment of the Jewish national home and the interests of the Jewish population in Palestine, and, subject always to the control of the Administration, to assist and take part in the development of the country.
>
> The Zionist organisation, so long as its organisation and constitution are in the opinion of the Mandatory appropriate, shall be recognised as such agency. It shall take steps in consultation with His Britannic Majesty's Government to secure the co-operation of all Jews who are willing to assist in the establishment of the Jewish national home.

Then the financial organization of Zionism took form. In the spring of 1918 the Zionist World Organization had launched the "Restoration Fund," which in June, 1920, was enlarged, becoming the "Palestine Immigration and Colonization Fund," "Keren Hayesod." This official financial organ, sanctioned at the Zionist conference in London, was registered in London in March, 1921. From April 1, 1921, to March 31, 1926, the Keren Hayesod alone expended considerably over £2,000,000 sterling in Palestine. Its work is twofold: it is in the first place general collector from Jews the world over, and steady propaganda is carried out by its two chief agencies in London and New York. In the second place it is the distributing agency among the various Jewish activities in Palestine that solicit help. In its transactions the Keren Hayesod has lately been aided by the General

[13] In 1924 and 1925 there was a considerable increase in the number of immigrants of the "independent means category." Taking the year 1925 as a whole, it is estimated that private capital thus introduced into Palestine amounted to £E.2,000,000. Memorandum cited in footnote 5.

Mortgage Bank of Palestine Limited, whose capital, £200,000 has largely been obtained in America. The Mortgage Bank has concentrated help on Tel Aviv where it has assisted in the building of 225 houses.

Up to now support has been principally given to agricultural colonization. From April 1, 1921, to March 31, 1926, £680,000 has been devoted to the agricultural colonies, 31 per cent of the total expenditure. Of the 100 existing colonies Keren Hayesod is "responsible" for the foundation and start of 44, in all 45,000 acres (185,000 dunams). It has also founded 4 agricultural experiment stations[14] and nurseries for at least 750,000 trees. To prevent loss of time and unnecessarily onerous work on the part of the community a number of immigrants have, through the care of the Keren Hayesod, received agricultural training in the countries of origin.

Besides the material there is the spiritual side. The Keren Hayesod almost unaided takes care of the vast and quite modern Jewish school system in Palestine: 20 per cent of its funds are expended thereon. Teaching is carried on in the language of the Prophets. At present there are over 600 teachers to 16,000 pupils distributed in 168 urban and rural schools, comprising 69 kindergartens, 86 primary, 3 secondary, 3 normal, and 7 technical or professional schools. The Hebrew University on Mt. Scopus, Jerusalem, formally opened in April, 1925, also owes two of its institutes, those for biology and chemistry, to the Keren Hayesod. Two others, microbiology and radiotherapy, are supported by the American Jewish Physicians Committee. The university has hardly yet begun to function in the usual sense, but it is hoped many young Jewish scholars will be drawn there as instructors and that ultimately there may be realized a center of Hebrew studies which will be the symbol of the resurrection of the spirit and the unity of Israel.

Awaiting this development the university is actively occupied with the health of the new arrivals, who, hardy or not, are always more or less affected by the climate and the endemic diseases of the East. The Hadassah, a Zionist medical organization, subventioned by the Keren Hayesod and the Joint Distribution Committee with the special coöperation of the "American Jewish Women," valiantly carries on the war against the anopheles mosquito and against trachoma, so general among the children. There are 17 Zionist hospital clinics and dispensaries functioning in Palestine, chiefly in the towns of Jerusalem (Rothschild Hospital), Tel Aviv, Tiberias, Haifa, Safed, and Hebron. Sanitary measures in the form of regular inspection and disinfection are carried out in the schools, the colonies, and the immigrants' ports of entry.

[14] Special mention should be made of the farm school for young girls, subventioned by the Women's Zionist Association and the Keren Hayesod.

But it is not sufficient to organize along modern lines these corners of Palestine reconquered by the Jews: they must be peopled. The Keren Hayesod devotes a good part of its fund, 13 per cent, to the organization and encouragement of immigration. It is from Europe, especially central Europe, that the greater part of this new exodus has come: In 1925 the proportion of Jewish immigrants from Poland was 50 per cent; from Russia and the Ukraine, 23 per cent; from Rumania, 6 per cent; from Lithuania, 5 per cent. Since the Revolution in Russia the Jews, who once furnished the strongest quota of its emigrants, have not left in such numbers that country where they have gained equal rights or perhaps an advantage over the rest of the population. The majority of the immigrants in Palestine—and this is the weak point of the scheme—have nothing to lose in the venture and everything to gain, for they are assured of work. They become the Haluzim, builders of the country—roadmakers, farm laborers, factory workers in the towns; or if they arrive with their families they are advanced a little money and land.

The Keren Hayesod has charge of all arrangements: the departure from Europe and the arrival at the great camps of Jaffa and Haifa where the immigrants are quickly placed. Distribution is accomplished with the efficient collaboration of two great financial societies, the Jewish National Fund (Keren Kayemeth) which buys the land in the name of the Jewish people and the Palestine Land Development Company; of various Jewish banks, the Workmen's Bank, the Jewish Colonial Trust, the Anglo-Palestine Company; and of private capital[15] which numerous Jews do not hesitate to furnish.

The Future

But—for there is a but! If the marshes are drained and the deserts irrigated, can we permanently transform into an agricultural folk these people who have never known the feel of the earth, never heard the call of the land? What of the farms and camps and tents in which there have been planted fervent intellectuals, illiterate tailors and shoemakers of the ghetto, and exalted students who would rather break stones along the highway than attend to the cares of husbandry, under the pretext that thus they build better the new Palestine? What a difference between their feverish activity, a little out of harmony with nature, and the cheerful serenity of the citizens of Tel Aviv, traders born to be traders. Let it not be forgotten that at present not one of the colonies is self-supporting; nor that boats are leaving full of immigrants whose hopes have been frustrated. It is said that in 1925 nearly 2000 returned whence they came: while

[15] From 1921 to 1924 the total of private capital engaged in industrial and commercial Jewish enterprises in Palestine is estimated at £1,400,000.

statistics of arrivals are well kept, there are no comparable figures of departures.

This perhaps is why the native Jews, the 60,000 Palestinian Jews, regard the newcomers curiously and without much sympathy. They do not regard as brothers these young men, dressed in Anglo-Saxon style, with khaki shirt open at the throat, knickerbockers, long hose and stout shoes, who, bareheaded, escort young women in white with short skirts, bare arms, and bobbed hair. The old Jew of the caftan, "wailing at the Wall," distrusts these rebuilders of Jerusalem, who arrive without Talmud or Torah, not to weep, but with Karl Marx as their evangelist. They mistrust their developed and modernized faith; and, in spite of the common religion, the groups remain distinct, strangers, even hostile. Furthermore, the national character of these newcomers is marked. In Palestine it is curious to note that the Jews among themselves not only remain Ashkenazim, from northern and central Europe, and Sephardim, Mediterranean, but Polish, German, Rumanian, etc. It is quite easy for an observant person to tell the country of origin of these many types where community of religion and language are the only common factors of understanding.

The most devoted Jews themselves wait with a certain, slightly anxious curiosity the outcome of this "experiment," as they call it. The diversity of the fundamental elements constituting the colony and especially the different sources—Anglo-Saxon capital, German material and intellectual organization, labor chiefly Slav—have been the forces up to now: will it be always thus?

And how will it be—and this is the vital point—if the heavy funds needed to maintain this delicate equilibrium should for some reason not be forthcoming?

SOUTHERN RHODESIA

A WHITE MAN'S COUNTRY IN THE TROPICS

Ethel Tawse-Jollie

IN Southern Rhodesia we have a country unique in many respects. Here is a community of white people living in the tropics and leading a life which is a compromise between that of such countries as India and a true European democracy. Climatically and politically it is a white man's country: socially it is a white aristocracy with a black proletariat. It is, of course, not altogether a new experiment in social evolution, since similar problems are encountered in South Africa; but contrasts are more pronounced in Rhodesia because the evolution of both white and black society has been comparatively much more rapid. We have covered, thanks to railways and telegraphs, more history in thirty years than the Cape covered in two hundred. Our white people have passed in a few years from the pioneer stage with its roughness and hardships to the era of up-to-date hotels and motor cars.

It is perhaps well to remind the reader of the distinction between Northern and Southern Rhodesia. Southern Rhodesia is a self-governing colony with a white population of 40,000, whereas the northern state is governed by the British Colonial Office and has only 2000 to 3000 white inhabitants, of whom many are civil servants. The Zambezi, which divides the two Rhodesias, is more than a physical boundary. There is good reason to think that it delimits the area in Central Africa nearest to the equator which can be regarded as a white man's country in any true sense, and this although there may be, even nearer, isolated areas where the temperature is far from unpleasantly hot, as in Kenya Colony for instance.

Occupation of the Country

Southern Rhodesia originally consisted of two native states, Mashonaland and Matabeleland, and these names are still used to indicate what are now merely geographical and racial divisions. In 1889, at a time when it looked as if a German cordon might be drawn right across the continent, Cecil Rhodes organized the British South Africa Company. Its purpose was to develop concessions acquired by him from the Matabele king, Lobengula, and bought from other concessionaires; and armed with these he sent a force of five hundred picked men as police and pioneers into Mashonaland. Two years

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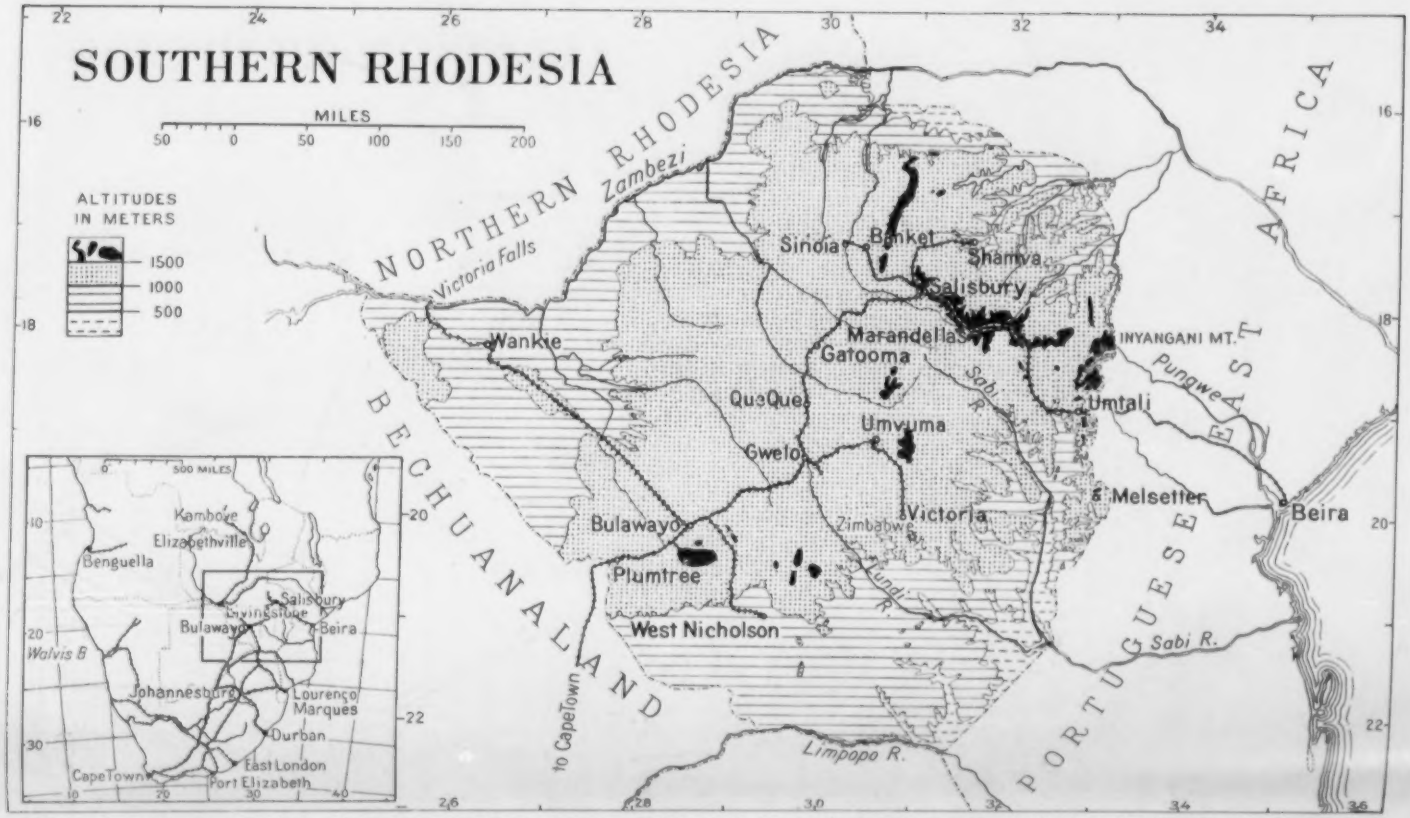

FIG. 1—Map of Southern Rhodesia. Contours 500 m. (1640 feet), 1000 m. (3280 feet), 1500 m. (4920 feet) from the (British) Geographical Section General Staff Map of Africa 1:2,000,000. Scale of map 1:8,000,000. Inset map (scale 1:75,000,000) shows rail communications with the exterior.

later they invaded Matabeleland and drove Lobengula into exile, where he died. They were then in possession of a large, fertile, and promising country with every prospect of finding a new reef. Nothing but such a possibility could have drawn a business company into such an undertaking; but as months went by and the rich reefs were still undiscovered, the situation became exceedingly difficult, for the resources of the company were limited and their commitments practically unlimited.

No help of any kind was forthcoming from the Imperial Government except that, when the withdrawal of the police force to take part in the Jameson raid and other errors of policy had led to a native rebellion, they sent troops to help establish safety but on the distinct understanding that the financial responsibility did not rest with them. This rebellion in 1896–1897 and the Boer war of 1899–1902 were serious interruptions to the settlement of Rhodesia; but the war, which had taken so many men away, subsequently helped to introduce newcomers both to the South African colonies and to the less known territory of the British South Africa Company. Many men who came out with the volunteer corps to the war were bitten with a taste for Africa and returned later as farmers and colonists. One or two schemes of community settlement were launched, in the Free State particularly; and these were assisted by the policy of Lord Milner of developing agriculture by improved stock, agricultural and experimental schools, and other measures calculated to improve the antiquated methods of the Boers.

From that time to the present there has been no systematic attempt to bring in fresh European blood, although every one agrees that it is highly desirable in view of the existing disproportion between black and white. Lately a society called the 1820 Settlers Society has been at work in the Union and has introduced some six hundred men, each of whom must have an available capital of £1500; but there appears from the statistics at hand to be a considerable leakage of British-born from the Union of South Africa at the same time, and a regrettably large percentage of the immigrants come from southeastern Europe. Southern Rhodesia gets quite an appreciable stream of immigration from the farmer class in the Union.

A Sovereign State

In 1923 Southern Rhodesia became a self-governing colony of the British Empire, a sovereign state under the King. She has her own parliament, at present of one chamber with thirty members; and she maintains her own defense force, a white mounted police and a volunteer organization as a second line of defense. The Constitution[1]

[1] The Constitution is given in the first official Year Book of the Colony of Southern Rhodesia, Salisbury, 1924.

Fig. 1.—Map of Southern Rhodesia. Contours 500 m. (1640 feet), 1000 m. (3280 feet), 1500 m. (4920 feet) from the (British) Geographical Section General Staff Map of Africa 1:2,000,000. Scale of map 1:8,000,000. Inset map (scale 1:12,000,000) shows rail communications with the ocean.

granted gives her full control of all affairs except that legislation as to natives and mineral rights and railways is reserved for the consent of the British Government. The first reservation is in accordance with British tradition in South Africa, the latter have due regard to interests of the British South Africa Company in these developments.

The Country Itself

A word as to the country itself. The colony is approximately 152,000 square miles in extent; and of that, roughly, one fourth is situated on a high and narrow plateau (the high veld) which runs from the Bechuanaland Border in a northeasterly direction through the country at an elevation of over 4000 feet and links up on the eastern border with a mountain range of even greater height, running up to 6000 and 8000 feet. An important spur runs north through the Umvukwes and links up with the Zambezi escarpment, which at varying altitudes runs along the north of the colony. The rivers in their middle courses have eroded deeply into the plateau producing a country of diversified relief, the "middle veld." "Middle veld" and "high veld" together constitute the bulk of the country, the "low veld" of the Zambezi, Limpopo, and Sabi basins being of limited extent. The lowest point, where the Limpopo crosses the boundary into Portuguese East Africa is 660 feet above sea level.

The drop to the Zambezi on the north and to the Limpopo on the south and also to the Sabi on the east is abrupt, and the tributaries running into those rivers have valleys that contrast in altitude and temperature with the plateau in their immediate vicinity, so that one cannot envisage Rhodesia as sharply divided into high and low, temperate and hot country. For the greater part of the year Rhodesia enjoys climatic conditions approaching the ideal, and this is true not merely of the high plateau but of many parts of the lower country where wind and rainfall contribute to temper the heat of the sun. The only parts of the territory where tropical heat is felt are the Zambezi and Limpopo valleys and the northwestern district (Wankie).

The seasons are two: winter, which lasts from April to September, being coldest in June and July, and the rainy season which begins with hot, thundery weather in October and cools rapidly from December onwards. A distinguishing feature are the cold nights which, both in winter and summer, are lower in temperature than those of most other regions with a similar day climate. Madeira, for instance, has a mean temperature of 65° F.; Southern Rhodesia a temperature of 66° at 4000 feet and 71.5° at 2000 feet; but the minimum temperature both at the coldest and hottest times of the year is lower in the colony than in the island.

The mean annual rainfall is 28.7 inches: on the east the figure is nearer 40 and on the west 20, and some districts bordering on Bechuanaland get less than 15 inches. At the time of writing (March, 1926), while the eastern border has had heavy rain and the Beira railway is flooded in an unprecedented manner, Bulawayo on the west is praying for rain. However, compared with other parts of the sub-continent the rainfall is stable (the standard divergence from the mean is 7 inches), and droughts are not so frequent as they are farther south. Rhodesia also possesses a number of large permanent rivers, and where such are not found water is easily obtained near the surface by wells and boring.

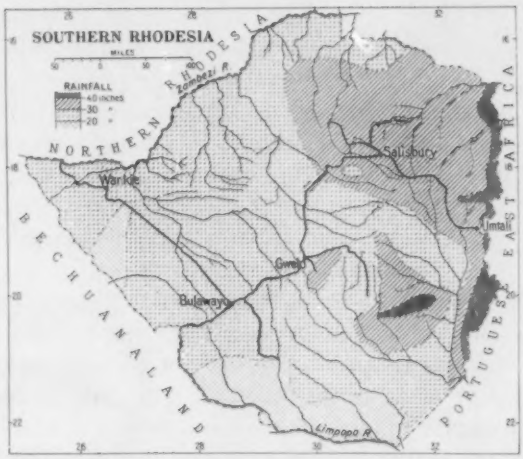

FIG. 2—Mean annual rainfall of Southern Rhodesia. Scale of map 1:13,000,000.

POPULATION DENSITY

It is usually remarked by visitors to Rhodesia that she is very English as to social atmosphere; and this is partly because they come through a country where, owing to a dual nationality and two languages, this effect is not produced. In reality her population is about equally divided, as to adults, between home-born and the South-African-born, and she has an appreciable contingent of Australasians as well. South Africa, after over two hundred years of European colonization, has a white population of 1,250,000 and 5,500,000 natives; Southern Rhodesia, after 30 years, has 40,000 whites and 860,000 natives.

It is customary to speak of these African countries as being sparsely inhabited, but in fact they compare favorably with many other "new" countries. Australia has an average of 1.53 persons, Canada 1.90, New Zealand 9.63, the Union 12.63, and Southern Rhodesia 5.87 to the square mile. Nor is it the case in Southern Rhodesia that the African population is increasing in greater ratio than the white, as might have been expected now that they enjoy peace and are cared for in famine and in sickness whenever possible. For Europeans the mortality is low: the death rate per thousand (unadjusted for age of population) was 12.6 for 1911–1920. The birth rate (unadjusted for sex ratio) was 27.74 per thousand, one of the highest in the Empire. There are now some ten thousand white Rhodesian-

born children in school, and in appearance they do not differ from the home-born, except in one or two places.

Native Reserves

It may very well be asked why settlement in such a desirable country has been, comparatively speaking, so slow. There are towns in Canada and Australia which were founded at the same time as Rhodesian settlements and which now have a larger white population. The point is that one cannot regard only the white population in this question. Very large areas, amounting in all to over twenty million acres, have been set aside permanently for reserves in which the natives live on a sort of communal tenure. Although in some cases tribes have had to be moved some little distance from their ancestral homes, this has not been done to any great extent nor are the reserves the poorest quality of soil. Still it happens, very largely from reasons connected with the primitive methods of agriculture, that some reserves are not likely to be adequate for the increase of population; and here the government has been trying to improve the output of the land by boring for water and by teaching better methods of cultivation. A commission on native lands has just reported in favor of setting aside considerably more land and permitting natives to acquire it by purchase—a right possessed by them at present but exercised very infrequently. The commission's proposals would make the European area approximately 62 per cent of the total, the native areas 37 per cent. The commission is in favor of a segregation policy, which involves both races giving up their right to purchase in certain areas. Segregation is now the policy in favor in the Union, but it may be premature to consider it in Southern Rhodesia at present.

Besides the 516,335 natives living in these reserves (which are scattered all over the country and not concentrated in any special area) there are 150,650 living on white men's farms, 122,000 on unalienated government land, and 24,874 in compounds attached to municipalities. The last constitute an urban population which in many cases has lost all tribal sense or touch with the land. They are employed as servants, mechanics, drivers, and on every kind of semi-skilled and unskilled labor. Despite the protection afforded to the white mechanic by his trade union one sees in Rhodesian towns an increasing number of native chauffeurs, motor mechanics, carpenters, and other workingmen. In short, the country is really a white aristocracy with a class of highly paid white workingmen, who in their turn are employers of the real proletariat, the natives. The figures given are suggestive, as they show that close on 300,000 out of a total of 860,000 are living on land which is or may be occupied by European farmers; and of these, two-thirds are indigenous natives.

Hindrances to Settlement

When, therefore, we inquire why the tide of emigration which, during the twenty years preceding the war, set so steadily away from the British Isles, has passed South Africa and Rhodesia by, we must remember that the average emigrant expects to be able to support himself by his own labor even if unskilled, at any rate for a time, until he has learned enough to become a landowner or employer. In countries where the native supplies raw labor this is impossible. Rhodesia admits no immigrant who does not appear to have either a job to go to, a sum of £50 for his own use, or some definite guarantee that he will not become a public charge. In the latter case he will be deported to his place of origin. A strict interpretation of other clauses of the Immigration Act is used to prevent the incursion of undesirables of any kind. When one adds the expensive railway journey which every immigrant must make to reach the Rhodesian borders, it is not a matter for surprise that the population has achieved quality rather than quantity. The government recommends that the farmer settler should have a minimum capital of £2000.

The racial reason has undoubtedly predominated in determining the course of development in Africa, but physical features are also unfavorable to rapid settlement. Had South Africa possessed great navigable rivers running to the south and east, her history would have been very different, for the problem of transport would have been simplified. As it was, her rivers presented a barrier to penetration of the hinterland, being raging torrents for a period of every year and dry chasms for too much of the rest.

Railways have now conquered these physical difficulties; but it must not be forgotten that the greater part of this huge continent was opened and colonized by ox wagon, which still remains the cheapest form of transport in many regions and the only one in some. Unfortunately there are cattle diseases encountered as one goes north which have from time to time swept almost the whole country. One such epidemic of rinderpest wiped out the whole of the transport to Rhodesia in her earlier days and forced Cecil Rhodes to hurry on the work of connecting the country with the outside world by rail and wire. At present there is a "fly" belt to north and east of the colony on the Zambezi and Portuguese frontier where cattle cannot survive, and in the Sebungwe district cases of sleeping sickness of humans have occurred. In order to maintain communications Rhodes had to construct a considerable length of line outside the company's territory, from Mafeking on the south and Beira on the east. The same controlling company built the line north to the Congo border, and the consequence is that if the Southern Rhodesian government desires to purchase the railways she will have to buy large sections that are not within her own borders; and the same difficulty attaches to any

attempt to fix rates or control railway policy, though these are not insoluble problems.

Railways and Farms

The railways were designed mainly to serve the mining areas, but it is noteworthy that they also run through the heart of the main plateau and therefore give access to the healthiest part of the country. There are 1252 miles of railway; and, if 25 miles is taken as representing an effective crop zone, these lines serve a farming area of 62,000 square miles, or 40,000,000 acres. "Unfortunately," writes General Hammond, who recently conducted an inquiry into Rhodesian railway affairs, "a relatively large part of this area is of poor soil, and its crop production is further restricted by conditions of high altitude and moderate rainfall." He goes on to point out that within a 50-mile zone at an altitude of 2000 to 3000 feet are included some 20,000,000 more acres of rich alluvial soil, suitable for cotton and grain production on a large scale. These valuable statistics must be read in the light of what has been done in recent years on the sand veld, with a low rainfall supplemented by conservation of water by special cultivation. Formerly light soil was considered useless, but many changes are taking place in agricultural theory as the result of experiment. At the same time the development of cotton and tobacco on the lower areas is altering ideas as to the value of land that is still some distance from the railways.

General Hammond estimates that there are in the 25- and 50-mile zones some 25,000,000 acres of moderate fertility and 41,000,000 of rich soil; but the present acreage of European cultivation is only 300,000, and of native about 1,000,000. The main barrier to greater agricultural production has been and still is the cost of transport, which the settlers have laid to the doors of a profiteering railway. General Hammond does not accept the view that the railways have, hitherto, exceeded legitimate profits. The subject is highly controversial, and it is only necessary here to give General Hammond's conclusions, without any of the arguments that qualify it. He says "If land settlement is to be speeded up and the immense latent resources of the country developed, the problem of cheap transport must be solved."

There is no single way in which, so far as one can see, this can be achieved. In Canada railways went before settlement, but the results have not justified the belief that the example is a suitable guide for Rhodesia. At present there is still good land on the railway or in the 25-mile zone that has not been settled because it was alienated in early days to land and mineral companies. The total area thus alienated is close on 6,000,000 acres, and the chartered company's own ranching and agricultural land amounts to about 4,000,000 acres;

but, as the company is doing a considerable amount of development, this does not come into the same category as that of the other companies. Many of these have spent and are still spending considerable sums in the country in the mining industry; but they have held their land, without condition or charge, as a set-off against losses incurred in other directions, and with the frank intention of waiting for a rise in value. They are now prepared to sell, but it remains to be seen if their terms are sufficiently attractive. Meanwhile the government is on the point of introducing legislation to tax undeveloped and unoccupied land which will act as a spur not merely to the land companies but to many private owners who have taken up, often at a nominal payment, far more land than they can profitably employ.

Another method of advance may be found in the development of branch feeder lines, not necessarily railways, since motor transport is only now coming into its own. Much of the best land is awkwardly situated for railway communication, but experience has proved that road construction is cheap and easy if suitable drifts or bridges can be made to cross the rather numerous streams. Road bridges have hitherto been conspicuous by their absence, and a great deal of time and money has been wasted in patching drifts which periodically are either washed completely away or much damaged and cannot be crossed by motor traffic in the rainy season. Both in this respect and in the matter of roads and all public works the country was hampered by the fact that, under chartered company rule, no capital could be borrowed but revenue had to cover construction as well as maintenance.

As soon as Southern Rhodesia was granted self-government she entered the London market for a loan and has experienced no difficulty in raising all she needs; and up to date, after two years' payment of the services of her loan, she is in the position of not having had to impose a single extra tax. Her revenue, which has been growing steadily for the last fifteen years, will exceed the estimate for the current year by about £300,000, and this although it only touched the million mark in 1920. It encourages the hope that the government, which has proceeded very cautiously, will in the near future be able to deal with the question of communications in a more courageous spirit. Modern immigrants will seldom take themselves and their families out of easy reach of a railway even if crop farming (like cattle) could be made profitable under such conditions. A most important link in communications is, however, outside the government sphere at the present moment. Unless the port of Beira can be improved and the railway from there to Southern Rhodesia secured against such floods as in 1925 and 1926 rendered it impassable for several months of each year, Rhodesia must link her railways with those of the Transvaal via Messina and take her goods to Delagoa Bay. Bulawayo

(via Salisbury) is 673 miles from Beira, whereas it is 1360 miles from Bulawayo to Cape Town. The construction of a connecting link would bring Delagoa Bay within more convenient distance of the main Rhodesian centers, and this will probably be one of the first new lines to be constructed. Another project is for a line running west to Walfisch Bay, but this could be built only with the goodwill of the Union and also (since it crosses Bechuanaland) of the Imperial Government. Although competent observers believe that it will come, the general impression is that the time has not yet arrived. A third route will run north and west with outlets both to the Congo and to the Atlantic at Lobito Bay; but, as at present planned, the former involves breaking bulk at least twice, whilst the distance by the latter is at present prohibitive for all but the most westerly districts. Nevertheless, it is apparent that Rhodesia will not always remain in her present comparatively isolated position and that her traffic will be a very valuable consideration for either of the routes to the coast (see Fig. 1).

Many persons are urging the government to embark on extensive schemes of land settlement. The writer is in favor of a policy of indirect rather than direct subsidization of settlement. Cheaper transport is the first need, and this should include assisted transport of suitable settlers from Great Britain. The expense at present deters many.

Land Purchase

Many different forms of land purchase and tenure have been tried in Southern Rhodesia, and there is no reason to suppose that we have reached finality. At present the basis is an agreement of purchase whereby the price plus five per cent interest is paid in half-yearly installments spread over 20 years. Obviously the price is the important question, and the land is graded according to quality and distance from rail, suitability for ranching or farming, or both. There has been a distinct tendency to overvalue land not merely on the part of the government—the British South Africa Company went to absurd lengths in this respect except in cases where it was itself acquiring property—but on the part of private individuals; and the success of some experimental crop in a particular district will send up the prices at once to an uneconomic figure. There have been booms in land as well as in minerals. Land in the neighborhood of the chief towns is steadily rising in price and in the case of Salisbury by leaps and bounds, as a suburban population increases. Civil servants and professional men in the towns almost invariably become landowners and look forward to retirement on their farms, and this is equally true of men engaged in mining.

Labor

Important as is transport in speeding up white settlement, it is not more urgent than the question of labor. Throughout South Africa, despite the large native population, this question is assuming acute proportions; nor is it likely to improve on the lines at present being followed. The Rand mines have from very early days been obliged to recruit their labor from the north; but it is surprising to find that Southern Rhodesia is also compelled to do this and has subsidized a labor bureau for many years past in order to secure a supply of alien labor. The number of natives in employment in an average year is 140,000; but of these 90,000 are aliens who come from the north to seek work in the colony. They are included in the census figures already given. Deducting them we find that 50,000 out of 170,000 adult male natives (allowing four persons to each family) are employed; but this figure is too high, as the "employed" include young boys, who are not "adult" in a European sense of the word.

It is a curious thing that Rhodesian labor goes to Johannesburg, while she recruits from Nyasaland and Northern Rhodesia, the attraction in each case being higher wages. Up to the present time this importation has resulted in a supply that has been adequate for the last few years; and wages, though rising, are still very low, 15 shillings a month for unskilled work and 5 to 10 more for drivers or head boys. The food ration is mealie meal with the addition of meat (quite a modern innovation) where it is cheaply procurable. The Labor Bureau boys get £1 per month and a standard ration of meat and meal and beans. They contract to work for a year and are not charged with tax. This tax, really a poll tax, is £1 a head for every adult man and 10 shillings for every wife after the first. Except a tax on dogs this is the only direct taxation of the native. To meet it he almost invariably chooses to work rather than pay it out of capital. His capital is mostly in the form of cattle, wives, and daughters, all of which are saleable; and to earn a wife, if his father cannot buy him one, he must go to the mines or to some other form of employment which will gain him £30 to £40 in a reasonably short time. With this he is set up for life. Cattle owners can pay for their wives in stock, but the reduction in the price of cattle has hit them rather hard lately. Although the words "buy" and "sell" have been used here, the custom of "lobola" is not really a matter of purchase, but of compensation to the father.

Native Development

The economic position of the native is obviously a very easy one, but it is built up on a standard of living that is hopelessly low. There is no margin for failure of crops, for unusual cold or rain; and every

year there must be months of discomfort which in old age lead to suffering. The winter passes and the sun shines and the grain ripens. The native sits in the warmth, fills his belly, drinks the beer brewed by his women folk, and forgets the evil days; or rather, for he is essentially a fatalist, he says to himself that this is life. We have to remember that every man over thirty-five was born in the time of Lobengula, when providence and forethought were needless, and that practically all are pulled back to the kraal and its conservative influences by the dead weight of their womenfolk. There are people who think that the cause of labor shortage is the education of the native. They forget that were it not for the increased demands for clothing, better food, and an improved standard of living there would be no incentive for him to work at all, so long as he could raise the amount required by the taxgatherer. The early settlers had the greatest difficulty in getting labor of any kind; and the number of natives receiving education did not reach four figures until 1911 and increased by slow degrees until about 1918, when it began to jump and now shows another ten thousand every year.

The traditional "settler" view of the native is that he is not intended by his Creator to rise above being a hewer of wood and a drawer of water, in which capacity he is essential to the white man and to the development of the country. The traditional missionary view is that he is just as capable of development under Christian influences as the white man and has the same right to dispose of his labor or to live as he pleases. Yet the missions expect their converts to be ready to perform the functions of hewers and drawers for them, nor is it clear that they could continue their work without these services. Moreover, the missionaries, although some were pioneers, owe their continued existence and the possibility of increasing their work to the farmers, miners, and administrators who came in and gave the country roads, towns, industries, and a stable government. Christianity would not have reached the vast majority of these people except for the men who opened the country and freed their fathers from the tyranny of Lobengula. Granted, therefore, that the white man is necessary to the development of a civilized country and that he cannot live in it and develop it without the black man's labor, in what way can the relationship best be regulated for the advantage of both?

It is here, the writer ventures to think, that some, though not all, missionaries in Southern Rhodesia and elsewhere are inclined to go astray. They are so eager to protect their converts from the exploitation which, it must be acknowledged, would have taken place if some settlers had had their way, that their influence, perhaps almost unconsciously, has been in the direction of prejudicing natives against all employment except under mission auspices. The result has been

pointed out in a very clear manner by one of the Nyasaland missionaries. For years past, Rhodesian employers, unable to get labor, have subsidized the recruitment of Nyasa and other northern boys and, as this missionary points out in a letter addressed to the Commission on Native Education (C. S. R. 20, 1925), the products of Nyasa missions today occupy the best posts open to natives in Rhodesia. As builders, carpenters, mechanics, gardeners, and domestic servants they are sought after and better paid than local natives because of their reputation. They are also employed on the best class of farm work and on mines, where a contract for a period of twelve months is an advantage. The object of the mission is to train them equally to be of service to the white man or to themselves. Nyasaland is not a white man's country, and the missions do not need to consider whether their pupils will compete with white mechanics; but this does not altogether explain the difference in their output.

It would be a bold missionary in Southern Rhodesia who would openly say that he trained boys for European employment; every one still maintains the pious fiction that the object is to send the native back to his kraal to carry on the traditions learnt in the mission school. Meanwhile, the cream of native employment goes to the aliens, and when the Rhodesian native begins to appreciate this he will feel dissatisfied. His main idea in seeking education is to increase his own market value, and it is often a shock to find that the white man does not recognize this. Boys who have learned a trade are in a better position, but they are few and far between and are often retained to work on the mission stations.

It must be realized that with the growth of European population the competition for labor will to a great extent protect the native from the undoubtedly too low wages of earlier days and the rate which is still paid in many districts; but when those wages are remembered it must also be remembered that the white man was and is struggling with the problem of development against almost overwhelming odds and that he has had no assistance worth mentioning from the vast majority of the natives. The labor problem was more acute at first than it is now, and it was solved only by bringing in (at great expense) northern boys and establishing a steady stream of labor from that source.

We can go even further. It is urged at all missionary congresses that the taxation paid by natives entitles them to a larger share of expenditure on such things as education, and it is true that their contribution to revenue is considerable; but it must be remembered that, on account of the rebellion of 1896–1897, the country has been forced by the Imperial Government to maintain a large and extremely costly white mounted police, whose presence would be unnecessary but for the native races. It is true there is now little chance of any

further native trouble, but a police of this kind is easier to raise than to decrease; and at present their work consists almost entirely of native cases, notably prosecutions for non-payment of taxes. That the taxes are not too rigidly collected may be judged from the fact that in the current year the Government is £30,000 in arrears.

Native Industries

There is a section of opinion among the native administrators and missionaries that favors the development of native industries on the lines adopted in the West Coast colonies or in the mandated territory of Tanganyika, where European settlers are not encouraged and where the Government organizes the growth and export of native products, such as palm oil, cocoa, cotton, and coffee. The writer believes such a policy to be contrary to the interests of Southern Rhodesia and for that reason is doubtful as to the policy of segregation. Neither the agricultural conditions, native habits, nor the transport facilities of the country lend themselves to large-scale native production, nor can it be expected to adopt what is really a plantation policy. It is true that the individual native grower does not necessarily belong to a plantation system, but in reality whether the plantation is run by the Government or by large firms it comes to the same thing. The native does the cultivation; seed, supervision, machinery, and storage have to be supplied and the crop financed up to the point where it gets a European market. This is essentially plantation production as opposed to real farming.

This is no argument against native production of food crops or any other crops the natives choose to grow with the same aid or encouragement as is given to a white farmer, but it is against the deliberate adoption of a policy of subsidizing the native as a producer of crops for export. At the same time it may be that the only way to avoid racial friction is to define the areas of settlement and encourage a peasant proprietor class to grow up towards the ideal of economic independence. That this can be achieved in Rhodesia by agriculture without capital expenditure is very doubtful, and in the long run labor will go where it can earn the most.

The utilization of the indigenous native to a greater extent is one of the pressing problems of the day, and no excuse is needed for the space devoted to it. The country cannot always rely on the northern boy, since the development of the Congo may set the stream flowing north; and, even were it not a condition of white settlement that there should be an adequate supply of unskilled and semi-skilled labor, it is eminently in the interests of the natives themselves that they should acquire the habits of regular work and, as wage earners, become also producers of wealth. The Government of Southern Rhodesia is

alive to the necessity of providing a stimulus and a reward for those who become useful citizens and is considering a scheme to enable them to become freeholders of land in suitable areas—a right they possess but which public opinion is averse to their exercising.

European Industries: Mining

Southern Rhodesia and the northern Transvaal show evidences of prehistoric colonization on a scale comparing favorably with their present population. It is not without significance that these "ancients," as we call them, were attracted by the mineral wealth; and at a rough estimate they took about twice as much gold out of Rhodesia as has been discovered in the thirty years of British occupation. Besides their abandoned mines, which constitute the largest mining area in the world in actual extent, there are thickly scattered about Rhodesia the ruins of dry-stone masonry of a very substantial kind but unknown origin, remains of terraces and watercourses, and other evidences of a cultivation which must have provided food for a much larger population than is now fed on the country. Controversy still rages as to the origin and age of these ancient remains, some persons asserting that they are simply the work of previous generations of natives (though this does not account for the mines nor for the absence of native traditions concerning the buildings), and others pointing to certain decorative or symbolic features as showing Arabian or Mediterranean origin, while it is generally conceded that the rock mining is similar to that found in India and that trees and plants of Indian origin are frequently seen near such mines and nowhere else.

Although we may begrudge the ancients the large amount of precious metal of which they denuded the country, we must acknowledge that, had they not so successfully prospected, the gold might still be undiscovered in the heart of an inaccessible and uncivilized native territory. It was the report of the old workings that led to the occupation in 1890; and today, if the ancients are nothing else to us, they have at least provided us with an attraction for tourists in the shape of Zimbabwe and other ruins and an unsolved problem of archeology.

Gold to the value of £57,522,000 has been exported from Southern Rhodesia since 1899. The best year was 1916 when nearly £4,000,000 sterling was taken, but the figure now seems stationary at about £3,000,000, placing the country seventh among the gold-producing countries of the world. Practically every mine being worked today was located in the early days and is on the site of old workings. Prospecting has been stagnant until last year when the government tried to revive it by a system of grants, but so far with no results to show.

A geological survey of the country is now completed and should be of the greatest assistance to prospectors. It is certainly hard to believe that the ancients, without the aid of science and in the days when the country was in all probability completely covered with forest and bush, discovered all that Rhodesia contains. No mining authority believes that the reefs are exhausted or that no more reefs will be found. Several minor discoveries recently and notably the recovery of a reef, at an unexpectedly great depth, in a mine that had been closed down have encouraged the hope that further and deeper excavation may be rewarded.

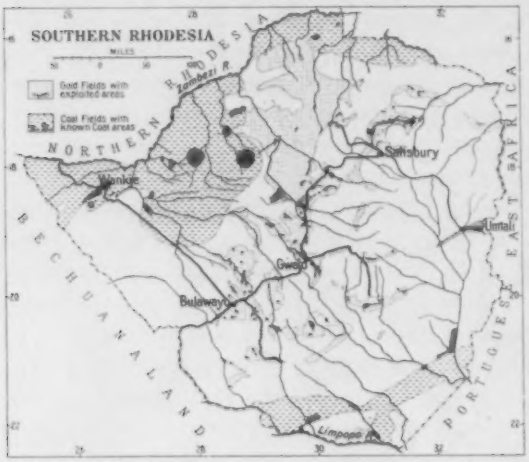

FIG. 3—Gold and coal resources of Southern Rhodesia. Scale of map 1:13,000,000.

Coal, worked only at one place, Wankie, although it is found in many others, accounts for two and a half million and an average annual production of about a quarter of a million. It is a monopoly of the British South Africa Company; and it is not in their interest to permit competition which, moreover, they could easily crush, as they have in Wankie one of the largest and richest coal fields in the world. The cost to consumers is high, not only on account of freight but also of pit-mouth cost, and it is to some extent a tax on industry.

Chrome ore and asbestos are next in importance, and they have been increasing considerably in value. They account respectively for £250,000 and for £600,000 to £700,000. Asbestos, being inexpensively worked, is one of the most profitable mining propositions in Rhodesia and is of recent development.

Copper, of which there is plenty in many parts of the colony, is dwindling for a variety of reasons, and platinum has not yet found its way into the available statistics although "finds" have been reported. Tin has been found in small quantities; and there is at the moment some interest being taken in corundum, which occurs in one district in considerable quantities.

The developments in mining will help to stimulate settlement, for, although a mining population is not, generally speaking, as permanent as a farming community, it has a strong tendency to become permanent in Rhodesia, especially among the smaller workers.

Agriculture

The staples of our agriculture are cattle, maize, tobacco, and latterly cotton. In the western districts with a lower rainfall and a good deal of light soil cattle predominate. There are about two million head in the country, divided pretty evenly between Europeans and natives. Pure-bred stock are on the increase, shorthorns being the favorite. In the last year or two dairying has become a very profitable industry especially in the neighborhood of the two largest towns.

During the war and for two years after, the price of cattle of any kind was high; but for the last five years Southern Rhodesia, like other cattle countries, has been suffering from a severe slump. The distance of her markets coupled with the fact that her southern neighbor, her best customer in the past, is now becoming a serious competitor and is imposing restrictions on the import of Rhodesian slaughter cattle, have combined to depress her prices so severely as to give a definite check to breeding. The depression has, however, had a good effect in convincing men that quality is better than quantity.

Last year the Government concluded an arrangement with the cold storage company that has a monopoly of South African internal trade, whereby, in exchange for the sole right to freeze and export from Southern Rhodesia, the company is to erect the necessary works at a stipulated expense. The agreement was in line with expert opinion that, in the absence of a good market for fresh meat or cattle on the hoof, cold storage was the only possible method of disposing of our beasts. Up to the present the cold storage works have not materialized, but the company has been buying on the hoof for the Johannesburg market and paying a very low price. Interesting experiments in sending live cattle to Italy and England have resulted in good prices and a favorable opinion of our stock, but the problem of cheaper transport has to be solved.

There is another market in the Congo, which has also been partly closed to us by the jealousy of Northern Rhodesia, although she could not supply it from her own European-owned herds. Both the Union and the Congo, however, are practically obliged to come to us, and the traffic is likely to increase when some of the political motives for trying to exclude Southern Rhodesia have ceased. Our cattle are in prime condition at a time when South Africa needs them, and the Congo demands will increase rapidly.

Until lately maize stood alone as the one agricultural product that could be regarded as a staple export. Tobacco had been tried, proved successful, but was killed by the monopoly of a company which dictated prices all over Africa. It could not be profitably shipped to England in competition with American leaf. A preference given to Empire-grown leaf has in the last two years revived this industry,

and it is now one of the most profitable in the colony. Bright leaf of very good quality can be grown on a large proportion of the farming soil, and a grade suitable for pipe tobacco over a much larger area. Cotton, too, has been grown for some years, but was not profitable at the prices current until recently; and now it is the subject of government experiment to decide the best soil, method, and seed to ensure a high standard of staple and yield.

Southern Rhodesia's hope in all production is quality, which she has already secured in maize, tobacco, and cotton. If the highest standard can be maintained she will not feel the handicap of her long haul to the coast so severely. It is for this reason that only farmer settlers with capital and brains are likely to do really well; and the native grower, unless heavily subsidized and supervised, might prove a source of weakness. Haphazard methods, of which we have had a good deal in the past, are not going to succeed longer. The government has a fully equipped scientific agricultural staff, a large veterinary staff, and a small but exceedingly efficient bacteriological staff for animal diseases; and with this up-to-date equipment a farmer ought to be able to start on the best lines.

Conclusion

From many aspects this experiment in tropical colonization is of peculiar interest, and the writer is hopeful that the courage which carried Southern Rhodesia through an exceptionally trying period and caused her to choose self-government rather than risk the loss of her identity in the Union of South Africa will stand her in good stead and enable her to take long views and brave decisions in the days that are to come. It is more than probable that this small white community is the nucleus of another self-governing nation within the British Empire and that in time to come its position in the heart of the African continent will give it strategic importance from the racial and economic as well as from the military point of view.

THE WINELAND VOYAGES:

A FEW SUGGESTIONS

Halldór Hermannsson

SINCE no authenticated Norse remains have as yet been found on the American continent[1] we have no way of verifying or controlling the accounts found in the Icelandic sagas of the discovery of America and the attempt at colonization there in the eleventh century. The accounts themselves, however, are of such a character as to leave no doubt that they deal with historical events. Even the discrepancies between the two principal sources, the Saga of Eric the Red and the Tale of the Greenlanders, tend rather to strengthen the conviction of a trustworthy tradition which has taken a slightly different form in different localities. These differences, however, make it more difficult to arrive at plausible conclusions about the course of the voyages and the places mentioned. To those familiar with the saga literature in general there can be no question that the Saga of Eric gives the impression of greater reliability, and in its favor also is the fact that it is the older of the two sources. Therefore, in my opinion, it must be taken as a basis for any treatment of the subject, while certain details found only in the Tale deserve due consideration.

The Story of the Voyages

The main features of the story are as follows: Leif Ericsson on his way from Norway to Greenland by the southern route, that is directly from Norway without touching Iceland, was driven out of his course and finally came upon a land which, on account of the presence of wild grapes, he called Wineland. He continued his voyage northward in the same summer until he reached Greenland. A few years later the Icelander, Thorfinn Karlsefni, started from Greenland on an expedition to Wineland with three ships and with the intention of settling there. He followed Leif's route, going in the opposite direction. After crossing Davis Strait he first sighted a land which he called Helluland, or Flagstone-land, then Markland, or Forest-land; thereafter he sailed along a long, low, and sandy coast which he called Furdustrandir, or Wonderstrands, and finally arrived at

[1] Referring to the ruins in Labrador to which a Norse origin has been accredited, Mr. Gathorne-Hardy points "in the most guarded language" to the "possibility" that they have been erected by an Eskimoized Norse people (G. M. Gathorne-Hardy: A Recent Journey to Northern Labrador, *Geogr. Journ.*, Vol. 59, 1922, pp. 153–169).

a bay which, because of strong currents, he called Straumfiord. There the first winter was spent. Next summer he continued the voyage southward to Hóp, which he seemingly looked upon as a part of Leif's Wineland and where he spent the second winter. The following summer he returned to Straumfiord, spent the third winter there again, and returned to Greenland during the fourth summer.

Leif's Route Northward from Wineland

Since Rafn, in the earlier half of the nineteenth century, tried to identify these names with various localities on the east coast of America, many attempts have been made to find a solution of the problem.[2] No general agreement has yet been arrived at, which is natural considering the material we have to work with. The chief mistake made by most writers on the subject is the attempt to reconstruct Karlsefni's route towards the south, without first investigating the route Leif followed on his way north. The point is fundamental, because the route was established from south to north. It can be taken for certain that Karlsefni had with him as guides some of the men who had been with Leif; but, as they had sailed over the course only once, it must have been difficult for them to keep it, especially as they were now going in the opposite direction.

Let us then first follow Leif on his voyage. He probably lost his way somewhere in the mid-Atlantic and was driven by easterly or northerly winds into the foggy region of the Newfoundland Banks. It would be most natural to believe that he had struck either Newfoundland or Nova Scotia, but in neither of these would he have found grapes; so, following the lead of the Saga, we must assume that his landfall was farther south, somewhere on the coast of New England south of the northern limit of the wild grape, which, I believe, is generally supposed to have been near Passamaquoddy Bay. From there he would naturally follow the coast towards the northeast, probably going into the Bay of Fundy only to find that there was no through passage and so rounding Nova Scotia and Cape Breton until he came to Cape North where the land ends. From there he is not likely to have turned to the southwest to follow the coasts of Prince Edward Island and New Brunswick. From Cape North at sea level he could hardly see Newfoundland even under the most favorable circumstances; the distance is too great, and, besides, Cabot Strait is notorious for dense fog during the summer months.

The most natural thing for him to do, it seems to me, was to take the course due north from the cape. In such case two things might

[2] See W. H. Babcock: Recent History and Present Status of the Vinland Problem, *Geogr. Rev.*, Vol. 11, 1921, pp. 265–282; and a recent paper by Gustav Holm: Small Additions to the Vinland Problem in consequence of Professor H. P. Steensby's "Norsemen's Route from Greenland to Wineland," *Meddelelser om Grønland*, Vol. 59, 1925, pp. 11–37.

have happened. Either he struck the southwestern portion of Newfoundland near Cape Ray and thence sailed along the west coast of Newfoundland northwards; or he went into the Gulf of St. Lawrence between Newfoundland and the Magdalen Islands and continued his

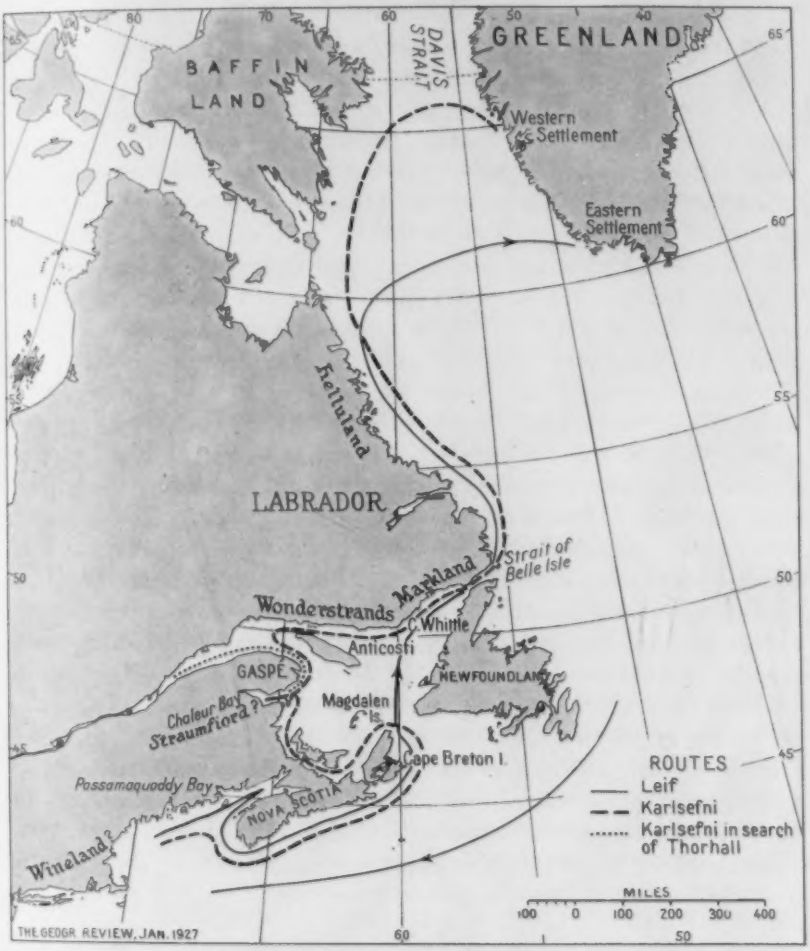

FIG. 1—Sketch map showing the courses of the Wineland Voyages and identification of places mentioned in the sagas (in antique lettering). Scale 1:25,000,000.

voyage until he became aware of the south coast of Labrador, which he then followed eastward. In either case he must have gone through the Strait of Belle Isle. This is of importance because, unless Leif went out through the Strait, Karlsefni is not likely to have passed in. It is so narrow as to look like a bay from the outside, and it took later explorers some time to discover that there was a passage through there. After passing the strait Leif, of course, followed the east coast

of Labrador until the time came to cross Davis Strait in order to reach Greenland.

Karlsefni's Southward Voyage

Having thus traced Leif's probable route, we turn to Karlsefni's voyage from north to south. According to the Saga he crossed Davis Strait from the Western Settlement, or even a little north of it. He then sailed southward along the east coast of Labrador until he reached the Strait of Belle Isle, probably well remembered by the men of Leif's crew. He passed through it and kept to the south coast of Labrador. His ships were heavily loaded with live stock and other things necessary for settlement, hence, as Hovgaard has suggested, his voyage was probably slower than that of Leif, and the season was fast advancing. He saw the land stretching southwestward and probably was tempted to follow it, possibly in the hope of finding winter quarters there instead of sailing out into the gulf. Very likely the guides were uncertain about the route. Anyway he followed the south coast, discovered first a thickly wooded country and thereafter a long, low, and harborless shore. He presumably sailed along this until he came into the estuary of the St. Lawrence and saw the high peninsula of Gaspé on the south side, to which he turned leaving this desolate coast behind. Realizing by this time that he had gone much farther west than Leif and not seeing any particularly attractive place for settlement, he may have turned eastward along the northern shore of Gaspé. Or he may have seen the northwestern point of Anticosti Island and sailed from the Labrador coast towards that and thence to Gaspé, whose bold northern shores would probably be visible under favorable conditions. In either case he must have proceeded along the east coast of Gaspé until the waters of Chaleur Bay opened before him and he saw the inviting landscape around the bay in all its late summer beauty. One can easily imagine that this made a strong appeal to the weary voyagers, so that they decided to settle here or, at least, to spend the winter.

Identification of Straumfiord

Various things lead to the identification of Chaleur Bay with Straumfiord. The Saga describes Straumfiord thus:

> There was an island at the mouth of the fiord, about which there were strong currents, wherefore they called it Straumey. There were so many birds there that it was scarcely possible to step between the eggs. They sailed in through the fiord and called it Straumfiord and carried their cargoes ashore from the ships and established themselves there. . . . Mountains were there, and it was beautiful to look about. . . . There were great pastures.

Compare this with Cartier's description of Chaleur Bay when he discovered it in September 1534:

> . . . the land toward the south of the said bay is as fair as good land, arable and full of as goodly fields and meadows as we may have seen, and level as a pond; and that toward the north is a high land, with mountains all full of trees of tall growth, of many sorts, and among others are many cedars and firs as goodly as it may be possible to behold for to make masts sufficient to mast ships of three hundred tons or more; in which we did not see a single place void of woods, save in two places of low lands, where were very beautiful meadows and lakes. . . . Their land is more temperate in heat than the land of Spain, and the most goodly that may be possible to see, and as level as a pond. And there is not here any little spot void of woods and made up of sand, which may not be full of wild grain, which has an ear like rye, and the kernel like oats, and peas as thick as if one had sown and cultivated them; gooseberries, white and red, strawberries, raspberries, and red roses, and other herbs of sweet and powerful odor; likewise there are many fair meadows and good herbs, and ponds where there are plenty of salmon.[3]

There is undeniably some similarity between the two descriptions, the Saga, true to its traditions, not entering into so minute details as the French account. Whether, however, there are such strong currents in Chaleur Bay as would warrant its being called Straumfiord, I do not know. Outside, off the mouth of the bay, and especially on Miscou Bank, the currents and tidal currents are irregular, both in rate and direction; the tide rises at Miscou Harbor to five feet, while at the head of the bay, at Campbellton, it is ten feet.[4] The two islands at its mouth, Miscou Island and Shippigan Island, might easily have become one in the tradition; even at the present day they are extremely rich in bird life and in that respect correspond well to the description of Straumey. One also gets the impression from the Saga that Straumfiord was quite large, since Karlsefni and his men devoted the rest of the summer to the exploration of it and of the surrounding country. The objection may be raised that they spent two winters in Straumfiord apparently without coming in contact with the natives. In Cartier's day Chaleur Bay was much frequented by the Indians because of its excellent fisheries. This, of course, may have been different five hundred years earlier.

But what was fine and fair in summer took on a totally different aspect in winter. There were marked contrasts between the seasons in Straumfiord as in Chaleur Bay. Karlsefni and his men, enraptured by the beauty and bounty of the summer, took no thought to provide for the winter. This was very severe: the water froze and the fisheries failed, so that they came near starving. Only improvement in the weather, which made it possible for them to row out to sea, and the coming of spring saved them. All this had caused great disappointment among them. Thorhall the Hunter, who had been an unwill-

[3] J. P. Baxter: A Memoir of Jacques Cartier, New York, 1906, pp. 102 and 106–107.

[4] St. Lawrence Pilot, 5th edit., *U. S. Hydrogr. Office Publ. No. 100*, Washington, 1925, pp. 49, 211, and 213.

ing member of the expedition from the start, complained that they had found no grapes and that he had not got "the best of drinks" which he had been promised before leaving Greenland. This he expressed in two ditties included in the Saga. They are undoubtedly genuine and show conclusively that Straumfiord must be sought outside the northern limits for wild grapes. Thorhall with other malcontents took one of the ships and left for Greenland. Karlsefni also realized that he must seek a better place, so he went southward east of the country with the two remaining ships. If my theory as to Chaleur Bay is correct, that means that he followed the coast and went east of Nova Scotia, which would well agree with the phrase used in the Saga, and thus picked up Leif's tracks again. He sailed until he came to the place which he called Hóp where he found similar conditions to those Leif had discovered in Wineland. But whether Hóp is identical with Leif's landfall is another matter. Anyway, if we accept the story of the grapes as true, this place must have been south of Passamaquoddy Bay. There are many theories as to its location, but into that I shall not enter here. Although Karlsefni was greatly pleased with the land and the climate there, he had to leave next summer because of the hostility of the natives.

Markland and Wonderstrands

I have dwelt so long upon Straumfiord because its identification with Chaleur Bay is my own suggestion, while part of Karlsefni's route as outlined above has previously been suggested by Professor Steensby in his book "The Norsemen's Route from Greenland to Wineland,"[5] although his premises are somewhat different from mine. As to Helluland there seems to be a general agreement among writers on the subject that its description in the Saga fits the east coast of Labrador. But regarding Markland and Wonderstrands there is a great difference of opinion. I am inclined to agree with Steensby that these two are to be sought on the south coast of Labrador.

The Saga says that Markland had a large forest and many wild beasts. An island lay southeast from it, and upon that they found a bear; hence they called it Bear Island. This could well be the northern point of Newfoundland, which they almost inevitably would have taken for an island if they went through the strait. In such case Markland would be the south coast of Labrador not very far west of the Strait of Belle Isle. The desolation of that coastal region has been vividly expressed by Cartier's characterization of it as the land God allotted to Cain. In regard to which a modern writer remarks: "A short journey up any of the rivers which reach the coast of southeastern Labrador, however, will take the explorer into a densely wooded

[5] H. P. Steensby: The Norsemen's Route from Greenland to Wineland, Copenhagen, 1918.

country which has no resemblance to the barren coast line and will convince him of the injustice of this description."[6] While it is not likely that our explorers at that stage of their voyage went very far inland to investigate the country, they are almost sure to have made some survey of the land beyond the nearest shore. So the objections raised against locating Markland here do not seem to have disproved our theory. The Tale has a slightly different description of Markland: "This was a level wooded land, and there were broad stretches of white sand where they went, and the slope down to the sea was not very abrupt." Here evidently is a peculiar feature which made an impression upon the voyagers and which the Saga has forgotten but which the Tale has preserved. This supports our theory. Just inside of the Strait of Belle Isle is Blanc Sablon, so named by Cartier "owing to the whiteness of its sandy shores when seen from the deck of a ship on a sunny day."[7]

After leaving Markland Karlsefni and his men, the Saga says, "sailed southward along the land for a long time and came to a cape; the land lay upon the starboard; there were long strands and sandy banks there. They rowed to the land and found upon the cape there the keel of a ship, and they called it Kialarnes (Keelness); they also gave a name to the strands, and called them Furdustrandir (Wonderstrands), because they were so long to sail by." These strands have been a particular stumblingblock to commentators, because no feature on the east coast of America facing the open sea answers such a description. Beginning with Rafn many writers have identified Wonderstrands with Cape Cod. But that is out of the question: they cannot be so far south, and it would not have taken the voyagers long to sail by that short strip of coast. Professor Steensby has pointed out a place that corresponds to the description. He writes: "I do not hesitate to maintain that it would be impossible to find a stretch of coast on America's northeast coast which better suits the account of the Saga than does the coast of Labrador, especially the stretch to the west of Cape Whittle."[8] And I agree with him, although I find that the rest of his theory as to the further progress of the voyage is absolutely untenable. This coast is little known, but the few available descriptions are in harmony with the characterization, from Cartier who speaks of the coast "wholly ranged with sands without having there any appearance of a harbor" to C. W. Townsend[9] who follows the succession of beaches on the Côte Nord and points out as a distinguishing feature of this coast "its long reaches of sandy shores." Sand bars characterize the mouths of most

[6] E. M. Kindle: Notes on the Forests of Southeastern Labrador, *Geogr. Rev.*, Vol. 12, 1922, pp. 57-71; reference on p. 57.

[7] Baxter, *op. cit.*, p. 83.

[8] Steensby, *op. cit.*, p. 47.

[9] C. W. Townsend: A Labrador Spring, Boston, 1910.

of the numerous rivers, and, according to the St. Lawrence Pilot (p. 347), "the appearance of this coast from the distance of about 12 miles is so little diversified that it is almost impossible to distinguish one part of it from another."

When Thorhall the Hunter left Straumfiord he pretended that he was going to seek Wineland to the northward beyond Wonderstrands. Next summer upon his return from Hóp to Straumfiord Karlsefni set out with one ship in search of Thorhall. "They sailed to the northward around Keelness, and then bore to the westward, having land on the larboard. The country there was wooded wilderness." We have probably to allow for some confusion here concerning Keelness, since that place according to the Saga was on or near the Wonderstrands. But if Straumfiord is Chaleur Bay, Karlsefni on this trip seemingly sailed around the Gaspé peninsula and followed the north coast of it westward into the estuary or river of St. Lawrence, and it was here, at the mouth of one of the small rivers, that Thorvald Ericsson was killed by the uniped. We are not likely now to put much credence in the existence of such fabulous beings. But as a curiosity I may mention that Donnacona told Cartier at Stadaconé that he had visited a country "where the people have only one leg."[10] Could there possibly be any connection between the two stories?

What I have set forth here is merely a few suggestions which seem quite plausible to me. What others think of them remains to be seen. But so much has been written and so many theories advanced with the aid of books and maps, on this subject, that it is very desirable that some one should take the matter up in a more practical way and actually investigate these regions to see whether some light cannot be thrown on this interesting problem of historical geography.

[10] Baxter, *op. cit.*, p. 199.

THE PHYSIOGRAPHIC INTERPRETATION OF THE NAUTICAL CHART

Raymond Stanton Patton

U. S. Coast and Geodetic Survey

ON September 1, 1923, southeastern Japan was devastated by a great earthquake which, although probably not so severe as others which have occurred in that region in historic times, was unprecedented as to the number of lives lost and the magnitude of the property damage.

This disaster momentarily focused public interest on the necessity of seeking in every possible way to minimize the economic effects of these seismic disturbances. It also gave added impetus to the more serious and sustained interest of geophysicists, already actively seeking the solution of the same problem.

An important element in this problem consists in determining the character of the earth movements accompanying the disturbance. Thus, the Federal government has recently completed an extensive triangulation in California to measure the change produced by the San Francisco earthquake in the positions of a large number of pre-existing triangulation stations on either side of the fault line.

In other cases the center of the disturbance is located beneath the bed of the ocean. The recent Japanese earthquake is an example of this group. Shortly after that disaster soundings were taken in the Bay of Sagami which led the Imperial Marine Observatory to conclude that "if the materials which had been used for tracing the chart of Sagami Bay did not comprise large errors" there had been a maximum subsidence of 259 fathoms and a maximum upheaval of 135 fathoms.[1]

The excerpt quoted is a significant recognition of a limitation on basic data not always taken into account. Nautical charts are in constant use not only in these seismological studies but also for research in a wide range of geological investigations, and proper use for such purposes demands a critical appraisal of the contained data and that the deductions from them be limited to such as their probable accuracy warrants.

The critical evaluation of a chart demands an intimate and detailed knowledge of all the factors involved in its production. The present discussion will be limited in its application to the charts produced by the Coast and Geodetic Survey, concerning which the writer can

[1] K. Suda: On the Great Japanese Earthquake of September 1st, 1923: *Memoirs Imp. Marine Observatory, Kobe, Japan*, Vol. 1, No. 4, 1924, pp. 1–6, 137–239, and 1–49; reference on p. 168.

speak with the necessary measure of authority. It is believed, however, that the standards of accuracy of the Coast and Geodetic Survey equal those of the best contemporaneous practice of the charting agencies of other nations, and that the following statement may be accepted as indicating, in a general way, the limitations to which all charts are subject.

Utilitarian Purpose of the Chart

The purpose of the nautical chart is primarily utilitarian. It is the product of the obligation incumbent upon each maritime nation to furnish shipping the information necessary to safe navigation, to which every other purpose is subordinated. For example, in the field, surveys must be made first of the shoal areas which may contain dangerous obstructions rather than of the deeps, whose exploration admittedly would produce information of great scientific value but which are of minor interest to the mariner. Similarly, in the drafting room, the Mercator projection is used as the framework for the chart because that projection is particularly adapted to the mariner's needs, in spite of the fact that for general purposes it is less suitable than others available.

The task of surveying the waters of the earth is such a stupendous one that the combined effort of all participating nations has scarcely made a beginning of its accomplishment. Necessarily most surveys have been confined to the proximity of the land. With increasing departure from the shore and deepening of the water, the sounding lines become progressively more widely spaced and, when beyond sight of land, subject to uncertainties that will be discussed in detail later.

To illustrate with a single example: in a resurvey of the Atlantic coast now in progress by the Coast and Geodetic Survey, the section extending from abreast Chesapeake Bay entrance to the Straits of Florida is one in which moderate depths extend far offshore and where no great and abrupt inequalities in depth need be expected. This area is being covered by a primary system of sounding lines for which the specifications in general prescribe a spacing of sounding lines approximately as follows:

(a) From the shore to the 10-fathom curve, lines spaced ¼ mile apart, crossed by lines at right angles spaced 2 miles apart.

(b) From the 10- to the 15-fathom curve, lines spaced ½ mile apart.

(c) From the 15- to the 25-fathom curve, lines spaced 2 miles apart.

(d) From the 25- to the 100-fathom curve, lines spaced 4 miles apart.

On these lines the soundings are taken as rapidly as the depths permit: in less than 10 fathoms about 35 to 60 to the mile; between 10 and 20 fathoms, 20 to 35 to the mile; 20 to 50 fathoms, 5 to 10 to the mile; 50 to 100 fathoms, 1 to 5 to the mile. Any indication of shoaling revealed by these primary systems of lines is further examined later. Thus an area five miles square near the five-fathom curve would contain about 5000 soundings, while the same area at the 100-fathom curve would not contain more than 15.[2]

The standards of accuracy prevailing today were impossible of attainment a century ago when the Survey began its task. The art of hydrographic surveying has developed just as have other arts and sciences during that period. Take the case of improved equipment alone: the sailing ship has given place to the steamer, the hand-manipulated hempen sounding line to the steel piano wire carried on a motor driven reel, and both to the supersensitiveness of radio acoustics. The radio time signal is now broadcast daily, insuring the accuracy of chronometers to a small fraction of a second and thus making it possible to fix astronomic positions with a certainty previously undreamed of.

Depth Measurement

A hydrographic survey consists of a collection of soundings, each of which involves two separate and distinct operations: (1) the measurement of the depth, and (2) the determination of the point at which the measurement was made.

The immemorial method of sounding in deep water has been to bring the vessel to a complete stop and lower a weight to the bottom, recording the length of line unreeled in the process. Possible errors in the measurements may result from the lift of the waves, the overrunning of the wire after the lead has reached the bottom, and, most important of all, the drift of the vessel from its position directly above the descending lead, which must be lowered at moderate speed in order to be under control at all times. The effect of these errors is to give recorded depths greater than true depths. The percentage of error usually will be in inverse ratio to the depth, particularly if the latter be great and approximately known in advance of the sounding. A probable error of about two per cent in depths of 100 fathoms, and of one per cent in depths of 1000 is a reasonable assumption for carefully executed modern work of this character. The errors in soundings taken many years ago will be somewhat greater than those given above: on the average, one may say, they probably were about double.

To eliminate the disadvantage of this laborious and costly method

[2] In order to preserve legibility only a few of these soundings are shown on the published chart, but of course all are used for drawing the depth curves.

various devices have been introduced for sounding without reducing the ship's speed. Thus the depth is recorded by the compression of an imprisoned column of air lowered to the bottom. These pressure tubes have long been in extensive use by the merchant marine, but the Coast and Geodetic Survey has considered them too inaccurate and untrustworthy to meet the more exacting requirements of hydrographic surveying. Recently, however, the Survey has perfected a tube free from the defects of the commercial types and permitting an accuracy little inferior, if at all, to the sounding lead. It is now in constant use in depths less than a hundred fathoms. Special precautions are taken in use: each tube is calibrated separately for each day it is used, and for each cast two tubes are used. Occasional vertical casts are taken to compare direct and indirect measurements.

The writer recently has made further study of this method. Among other things he compared the simultaneous depth measures obtained from the two tubes used for each sounding. Each measure had been corrected separately for temperature and barometric pressure. The average difference between the shoaler and the deeper soundings of each pair on one survey was 1.7 per cent of the depth in depths ranging from 13 to 90 fathoms, and on the other 1.1 per cent of the depth in depths ranging from 13 to 70 fathoms. The mean of the two simultaneous measures, which is used as the sounding, would therefore appear in general to have a possible error of less than one per cent—this conclusion being based on the assumption that the calibration to which each tube is subjected on each day it is used takes satisfactory account of the systematic errors.

Echo sounding is the latest method of measuring depths in the deeper waters of the ocean.[3] This method is an adaptation of devices developed during the war for the detection of submarines. Very briefly, it consists in the accurate measurement of the time required for a sound wave to travel from the ship to the bottom and be reflected back again. The depth can then be deduced from the known velocity of sound in sea water, corrected for variations from the standard velocity dependent on conditions of temperature, density, and salinity.

The method is too newly developed to justify any discussion here of its present accuracy. It is mentioned rather because of the promise it holds out for the near future. The rapidity with which soundings can be taken will permit of examining interesting submerged areas with a minuteness not to be thought of under any previous method, and we can confidently hope that future developments will enable us to produce a contour map of a rugged sea bottom with an accuracy superior to that with which we map the topography of a mountainous region today.

[3] H. C. Hayes: The Application of Acoustics to Submarine Surveying, *Geogr. Rev., Special Suppl.*, Vol. 14, 1924, pp. 681–694.

Determination of Position

A record of depth is of no value unless we know the position at which it is measured. When the sounding is taken within sight of land, the position is determined by measuring the angles between known points on shore. As a rule we can assume that a satisfactory degree of accuracy is obtained. When the land is invisible, the determination of position is much more complicated and difficult. The methods ordinarily used in navigation and in the hydrographic work of the Survey until the last few years involve astronomic determinations or dead reckoning or a combination of both.

In the dead-reckoning method the vessel either starts or stops at a known point. She will run for hours or days without a "fix," the approximate position at any moment being derived by plotting, forward or backward from the known position, the course steered and the distance logged, corrected by the mariner's guess as to the effect upon his vessel of wind, waves, and currents. As all these effects are uncertain and variable, it is obvious that before many hours a small vessel such as is used for surveying, and particularly the small sailing ships of an earlier day, may be hopelessly "at sea." Where the vessel starts at one known point and stops at another, the intermediate run will be adjusted between the two; but such an adjustment is still subject to uncertainties. This method, therefore, has been used by the Coast Survey only in default of a better.

Positions determined by astronomic observation are by no means absolute. They are subject to uncertainties resulting from variations in the chronometer error or in refraction or from indefiniteness of horizon that cannot be taken account of in the computations. The writer has known carefully observed simultaneous altitudes of two stars on opposite sides of the zenith, taken under conditions that seemed normal to the observer, to result in positions five miles apart. Even now, with the chronometer error eliminated by the radio time signals, the careful navigator usually will assume a possible error of not less than two miles; in other words, that his vessel may be anywhere within a circle of two miles radius of which the computed position is the center.

Combinations of these methods controlled the offshore hydrography executed by the Coast Survey before 1914. In that year was begun a complete resurvey of the Atlantic continental shelf, for which much more accurate methods were developed. The hydrography, beyond the limit of visibility of shore objects, is now controlled by rows of buoys planted section by section over the area to be sounded. Elaborate methods are used in fixing the positions of these buoys with the result that the probable error in location is about fifteen meters to the mile. These unusually precise results apply only to work executed during and after 1924; in the previous decade the method, while

much more precise than any previously used, was still in the developmental stage.

Transmission of sound through sea water, whose application to the measurement of depth has already been noted, has also been applied to the determination of position. Briefly, a submerged bomb is fired from the ship, the instant of firing being recorded on a chronograph aboard the vessel. The sound wave, on reaching the shore, is picked up by a hydrophone. This operates a relay at the shore station which sends a radio signal back to the ship, where it is recorded on the same chronograph. All operations are automatic, and all transmissions are instantaneous except the sound from ship to shore; therefore the elapsed time on the chronograph between the sending and receipt of the signal measures the time required for the sound to reach the shore and consequently the distance. Three shore stations are used, giving the ship's distance from three known points and hence its position with a check. The method must still be regarded as in the developmental stage. Certain fundamental problems require further study, and their solution will undoubtedly result in greater accuracy. Tests indicate that at present the method is slightly inferior to that of measuring the angles between visible objects but superior to the buoy-control method.

Adjustments and Corrections

When the data accumulated by the surveying parties reach the Washington office of the Survey they are scrutinized to reduce inaccuracies. Such a scrutiny was particularly necessary to the work done before 1914. Data were first plotted, making allowance for all factors tending to produce differences between the true and the assumed positions. Where a portion of the work began and ended at known positions, the closing error was distributed throughout the run on the basis of the conditions prevailing while the work was in progress. Frequently the major system of parallel sounding lines was crossed by a second widely spaced system at right angles to the first. Depth contours were drawn and studied, and any parts anomalous to the known physiographic relief were subjected to further scrutiny to eliminate or reduce the anomalies. New work received was compared with all preëxisting data applicable to the same locality. This scrutiny, in modified form, is applied to present-day results, in spite of recent progress in insuring the accuracy of the field work.

In short, the cartographer spreads before him all pertinent data and by careful study seeks to harmonize every part. There is, however, a clearly defined limit beyond which he does not go. He is not permitted to make an "office survey," that is arbitrarily to change the field data to conform to his own individual notion of what is correct.

A factor which becomes noteworthy when our purpose is to study the configuration of a limited area of the ocean floor is that the relation between adjacent charted soundings is not necessarily a constant one. And where, as is frequently the case, the total of available data applicable to an area represents a piecemeal accumulation over a period of years, where the work was performed by sailing ships which zigzagged back and forth on erratic courses, the relationships may become so complex as to defy precise analysis. The results may fill the needs of the mariner and yet be too uncertain to justify use by the scientist for the deduction of conclusions regarding local physiographic forms.

The errors with which we are primarily concerned are the residuals remaining after the office adjustment has been completed. No specific rule for appraising their magnitude can be laid down, since it depends on the data and layout of each individual project and on the conditions under which the work was done.

Probable Errors

Some indication of the probable errors of data appearing on the charts pertaining to areas at a considerable distance from the land can be obtained by comparing the position of a characteristic depth curve, as determined by the recent relatively precise survey, with the position as charted before the application of the modern work. Figure 1 affords such a comparison. In the figure all soundings are in fathoms, and in each case the curve drawn as a solid line was determined by the recent survey, while the broken line is the same curve as previously charted.

The recent surveys were all made since 1916. The earlier positions rested on a meager accumulation of isolated sounding lines run as occasional opportunity offered during a long period of years. The 100-fathom curve south of Cape Hatteras was located largely as an incident to Gulf Stream investigations, where accuracy of position was in large measure subordinated to other objectives.

It is not surprising, therefore, to find these early contours misplaced five miles or more in some localities. Rather, it is gratifying to see how well the sequence of adjustments has reduced errors. Some of the closing errors of the dead-reckoning work were much larger, even when supplemented by astronomic observations. In the extreme case that has come to the writer's attention the vessel, on making a landfall after some days spent in the Gulf Stream under conditions such that no astronomic fixes could be obtained, found its reckoning to be sixty miles in error.

The conditions under which the early work on the South Atlantic coast was executed were probably as adverse as any in the Coast Survey work. Misplacements of the depth curves in excess of those

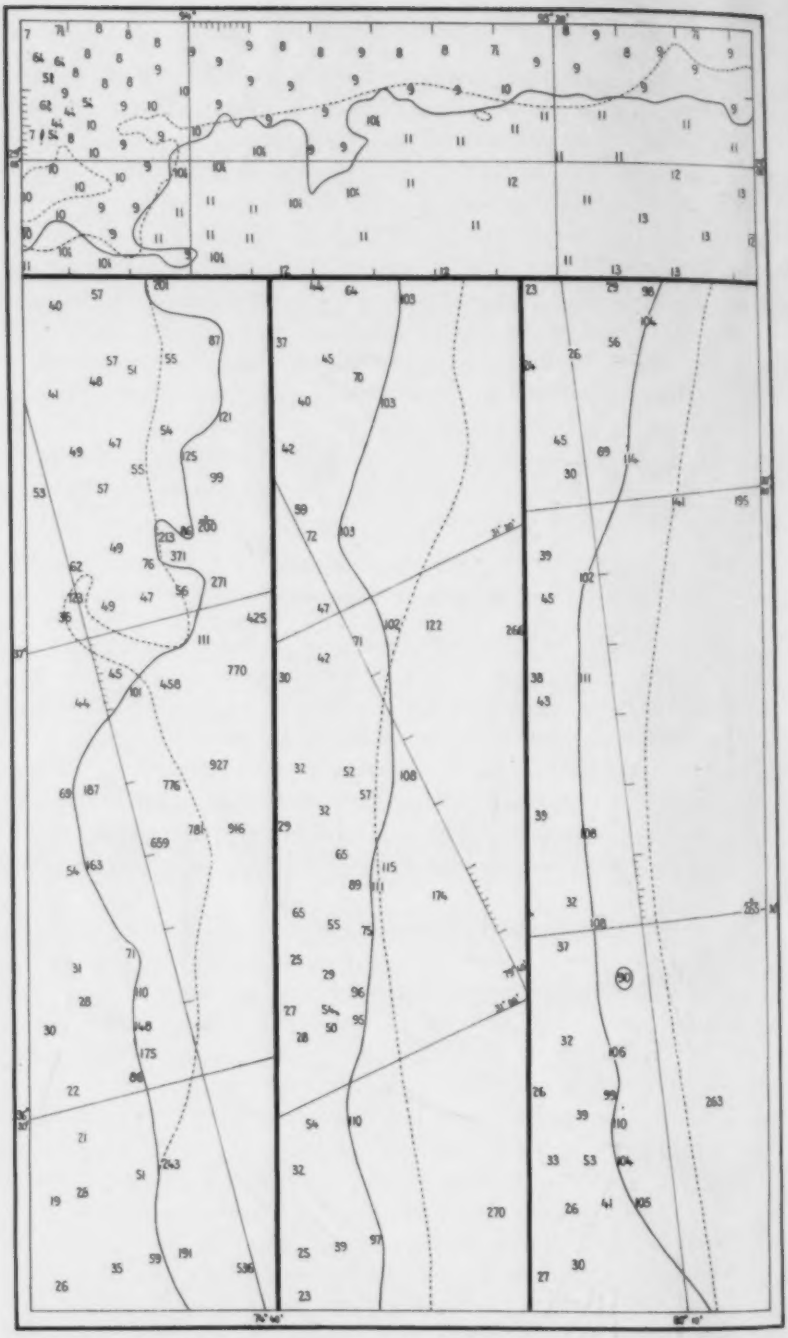

FIG. 1—Characteristic depth curves as determined by recent (solid line) and early (broken line) surveys along the Atlantic coast. Depths in fathoms.

The upper section shows the 10-fathom curve about 35 miles off Sabine Pass, Tex. The lower left-hand section shows the 100-fathom curve abreast Chesapeake Bay entrance, about 65 miles offshore: the middle and right-hand sections the 100-fathom curve from abreast the mouth of the Savannah River to a little south of St. Augustine, Fla., about 70 miles offshore on the average.

shown in the illustration need not be expected along any part of our Atlantic coast with the possible exception of the Gulf of Maine.

Another fruitful source of difficulty results from the charting of reports received from mariners, hundreds of which come to the Coast and Geodetic Survey every year. Many of these reports, although undoubtedly made in good faith, prove upon investigation to have no basis whatever in fact. But all chart-making agencies are guided by the principle that the mariner should be given the benefit of every doubt; and in cases where the information, if correct, would be of value it is charted until such time as an investigation can be made. Sometimes, but by no means invariably, it is qualified by the designation P. D. or E. D. (position doubtful or existence doubtful). As years may elapse before an opportunity for investigation arrives, these data, once charted, are prone to remain on the charts indefinitely. In the acceptance or rejection of information of this character the Coast and Geodetic Survey probably exercises a more exacting discrimination than most of the chart-making agencies of the world. Even so our charts contain hundreds of soundings which, though they cannot harm and may assist the mariner, should be regarded with suspicion by the scientist seeking exact data.

Countless instances might be cited of apparently authentic reports which subsequent investigation has proved to be wholly erroneous. A few months ago a battleship of a certain nation reported having obtained soundings of 13 and 14 fathoms off the California coast at a locality just outside the path of coastwise shipping where the charts showed 500 to 600 fathoms. This report was considered of such importance and of such unquestioned authenticity that it was immediately charted and broadcast to every port of the United States and to foreign countries. A Coast Survey vessel was ordered to make an immediate investigation of the spot. A detailed survey found not the slightest evidence to substantiate the report.

The Psychological Factor

A tragic event on the Pacific coast a few years ago illustrates how mistakes of this kind may occur. A large coastwise passenger ship was wrecked with the loss of the vessel and a number of lives. From the subsequent investigation it appeared that the vessel was proceeding in a dense fog by the method commonly practiced under such conditions of relying on the lead to keep in deep water. She could have reached the place where she stranded only by crossing a considerable expanse of shoal water. Yet the officer at the sounding machine at the very moment of striking reported, as he had been reporting for some time previously, no bottom at 100 fathoms. The most probable explanation seems to be that the sounder, believing the

vessel to be in deep water, allowed the lead to strike the bottom before he put his hand on the sounding wire to detect the impact signal and that the ship's speed was such as to unreel the wire at about sounding

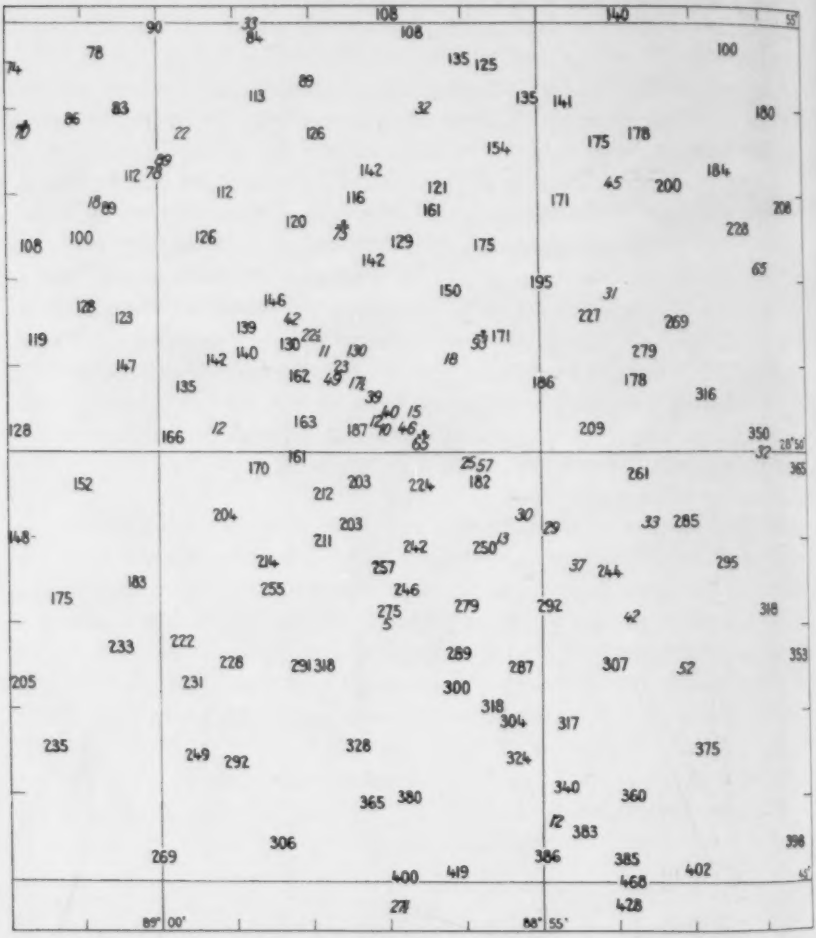

FIG. 2—Reported shoals off entrance to Mississippi River. Oblique figures show reported depths; vertical figures, depths found when searching for the shoals. All depths in fathoms.

A series of parallel lines trending in a northwest-southeast direction, which can be drawn through the reported soundings, represent the tracks of the reporting vessels. In this way the soundings of each report can be segregated from its neighbors.

speed, so that to all appearances the lead continued to descend until checked by the machine.

Thus there is an element of psychology involved in our problem of physiography. One other instance in which the psychological factor affords a possible explanation will be given. This example, the most interesting of its kind that has ever come to the writer's attention, is illustrated in Figure 2. Some time subsequent to 1900 the Survey

began receiving reports of shoal areas from 10 to 17 miles southeastward from the South Pass of the Mississippi River, directly in the track of the large ocean vessels bound to or from the river by way of the western end of the Florida Keys. Those reports were received in considerable numbers over a period of several years and indicated shoals several miles in extent. They were most convincing in character; discolored water would be noted, a series of soundings at short intervals would show shoal water, and the lead would bring up samples of the bottom.

On four different occasions a Survey vessel was sent to investigate the locality. In each case no trace of the reported shoals could be found, but instead the new soundings confirmed the depths already charted. Not only were hundreds of soundings taken in these examinations, but in addition the survey ship steamed many miles back and forth across the area towing a submarine sentry which would have given instant notice had it encountered a shoal. Some of these reports are shown in Figure 2 by the oblique figures, while the vertical figures show the depths found by the surveys.

One is reluctant to doubt such circumstantial evidence, yet the evidence of the surveys is even more convincing. Each reader is at liberty to deduce his own explanation. It is possible to justify both reports and surveys by assuming a sequence of volcanic or seismic disturbances; Bogoslof Island at once suggests itself as a precedent. Two objections, however, can be urged in opposition to this explanation: the remoteness of this spot from any region of known volcanic activity and the improbability that such disturbances could have occurred here without furnishing other confirmatory evidence. The psychological explanation has already been mentioned.

Physiographic Interpretations from the Chart

Space does not permit an extended discussion of doubtful conclusions reached by scientists as a result of a too confiding use of these data. A single example will be mentioned, because it so beautifully illustrates the point this paper seeks to make.

One of the most interesting physiographic features of our continental shelves is the submarine valley of the Hudson River. As a result of various scientific studies it has been visualized for us in terms of a grandeur that dwarfs anything we can see today. Deep narrow gorges with vertical walls and waterfalls of great height have been ascribed to it. While the more vivid descriptions have been intended to appeal to the popular imagination, they have adhered with reasonable fidelity to the more soberly stated deductions of various geologists, merely adding the touches of color necessary to give animation to the picture.

Most of these pictures have as their basis Spencer's studies of the valley. Those studies were based primarily on Coast Survey data, but with these data he arbitrarily combined information derived from other sources.

The aggregate of the soundings taken by the Coast Survey in this locality and used in the studies of Spencer and others were obtained at intervals during eleven different years from 1842 to 1905 and in some cases by two or more parties operating independently during the same year. In no case of soundings on any one line, whose relative positions with respect to each other would be approximately correct, were the soundings taken sufficiently close together to indicate inordinately steep slopes. In so far as deductions of such slopes were based on Coast Survey data they were derived from the juxtaposition of soundings whose relative positions were subject to the same uncertainties as their absolute ones.

Spencer's most striking deductions, however, resulted from his interpolation of extraneous information into the Coast Survey data. As he tells the story:

> But on the British charts I made a most astounding find of three soundings of 459, 801 and 229 fathoms. The position of the 459 and of the 801 soundings of the British chart so closely coincided with those of the Coast Survey chart (Coast Survey Chart No. 8 B. A. Chart No. 2480) at 213 and 345 fathom points that they could not have been represented on the same charts. Thus the British chart showed no barrier to the canyon and very greatly increased the known depth of the narrow gorge, further defined by the 229-fathom point. The extraordinary depth would have been startling had it not been anticipated in all of my long series of analyses of submarine valleys. Both series of soundings were correct, the deeper ones having been made by Lt. Com. Z. L. Tanner (Hydrographic Notice to Mariners, No. 56, 1883) in 1883 in the Fish Commission steamer Albatross. The older soundings had been retained on the Coast Survey charts.[4]

It need not be doubted that Tanner obtained the depths reported, thus suggesting the probability that the trough continued to deep water beyond the edge of the shelf. But the locations both of his soundings and of those of the Coast Survey to which they were related were far too uncertain to justify the derivation of a "precipitous" slope connecting the two.

The Coast Survey would not assert that Spencer's deductions were incorrect. It would merely point out the very great uncertainty to which they were subject. Assume three miles as reasonably possible errors for each of the soundings on which Spencer's conclusions depend. Then, considering only factors inherent in the survey, each sounding might belong anywhere within a circle drawn from the assumed position as a center, with a radius equal to the possible error. Then, at one extreme, the 801- and 345-fathom soundings might have

[4] J. W. Spencer: The Submarine Great Canyon of the Hudson River, *Amer. Journ. of Sci.*, Ser. 4, Vol. 19, 1905, pp. 1–15; reference on p. 5.

been over six miles apart, giving a slope of about four degrees. But since these circles overlap we have not precluded the possibility that the soundings actually were taken at the positions assumed and that the precipitous slope actually exists. Therefore before any satisfactory conclusion could be reached it would be necessary to obtain additional soundings or to take account of known factors foreign to the survey: for example, the geologic formation or the angle of repose of the material of which the exposed surface is composed.

THE BOUNDARIES OF THE NEJD

A NOTE ON SPECIAL CONDITIONS

AN international boundary is not always and everywhere a definite line to challenge the wayfarer. Sometimes it is in fact not a line at all but a zone, as in the region of northern Norway and Sweden, where a special convention accommodates the political geography to the physical and cultural conditions of the migratory Lapps.[1] Some of the treaties following the World War have given boundaries special qualities or functions as if they were an organ of international life and not a mere lineament. These features are a response to the needs of various rather primitive societies, specifically pastoral societies, to whom boundary restrictions might be not only vexatious but ruinous.

Recognition of Pastoral Necessities

In the Treaty of Kars signed October 13, 1921, between Turkey on the one hand and the Soviet republics of Armenia, Azerbaijan, and Georgia on the other, there is an agreement "to permit the rural population along the frontier to use their customary pastures across the frontier, permitting them to pass the frontier with their flocks in accordance with frontier regulations to be determined upon by a mixed commission." The final clause of the Angora Accord between France and Turkey (Oct. 20, 1921) provides that "the sedentary or seminomadic inhabitants enjoying pasturage or holding property on either side of the fixed line shall continue to exercise their rights as in the past": for the necessities of their exploitation they are to move freely acrosss the boundary without impost or tax. In the Angora Convention of May 30, 1926, between the same powers, this privilege is specifically applied to the inhabitants of a zone five kilometers wide on either side of the boundary. Similarly in the Treaty of Angora, June 5, 1926, between Great Britain, 'Iraq, and Turkey relative to the frontier north of Mosul, there are provisions for the maintenance of broad neighborly relations on the frontier as well as the prevention of unauthorized movements across it.

Italy and Egypt, by the terms of the Italo-Egyptian Accord (Dec. 6, 1925) respecting the boundary between Libya and Egypt, regulate nomadic affairs, provide for the use of wells on or near the frontier, and agree upon the terms of facilitation of caravans engaged in ordinary commercial transport. In the protocol of January 10, 1924, signed by

[1] K. B. Wiklund: The Lapps in Sweden, *Geogr. Rev.*, Vol. 13, 1923, pp. 223–242.

representatives of the United Kingdom and France, respecting the boundary between French Equatorial Africa and the Anglo-Egyptian Sudan (Treaty Series No. 28, 1924) there is a provision that the Wadi Howa is to remain "common to the tribes living on either bank and each tribe will retain such rights to dig wells, cultivate, and graze within the limits of the valley as they have hitherto enjoyed." One of the general clauses of this agreement states that "where the frontier follows a wadi, cuts a lake or rahad or changes its direction at either of such, the watering rights existing therein will be preserved by the inhabitants on either side."

Never before have international agreements so clearly recognized the geographical basis of a grazing society. Not only is there impact between rival grazing groups, there is also the pressure of the raider upon the settled communities in the river valley below the grassy steppes or elevated plateau where the nomad ranges free. On the nomad, Toynbee has this interpretive paragraph:

> His perpetual motion is not a symptom of waywardness and perversity. It is as scientific as the agriculturist's rotation of crops . . . Both are perpetually shifting the scene of their activities in order not to exhaust a particular parcel of ground . . . The nomad, ranging widely in order to convert grasses into human food through chemical transformations in the bodies of tame animals, regards the agriculturist as a stick-in-the-mud. The agriculturist, raising edible seeds and roots in sufficient quantities out of a much smaller area of land, regards the nomad as a vagabond.
>
> There would be nothing more in this than the commonplace mutual contempt of different trades, if the frontiers between nomad's land and peasant's land were stable. On his own ground, each of them is following that mode of life which the experience of generations has shown to be economically the most productive . . . . The traditional bitterness between peasant and nomad arises from a physical cause for which neither is to blame. Their respective environments and the frontiers between them are subject to periodic change . . . Yet while the intrusive nomad has been stigmatised as an ogre, the intrusive peasant has either escaped observation or has been commended as an apostle of civilisation. The reasons for this partiality are clear. One is that the nomad's tactics are more dramatic than the peasant's and make a correspondingly greater impression on the imagination. The other is that history is written for and by the sedentary populations, which are much the most numerous and sophisticated portion of mankind, while the nomad usually suffers and pines away and disappears without telling his tale. Yet, if he did put it on record, he might paint us as monsters.[3]

Boundary Agreements of the Nejd

When the governments of 'Iraq and the Nejd made their first boundary agreement in May, 1922, the Mohammerah Agreement, an article of the treaty recognized the right of any tribe belonging to one country to settle in the other country upon payment of a grazing fee. But it was necessary to go further than this on account of the

[3] A. J. Toynbee: The Western Question in Greece and Turkey, London, 1922, pp. 339–341.

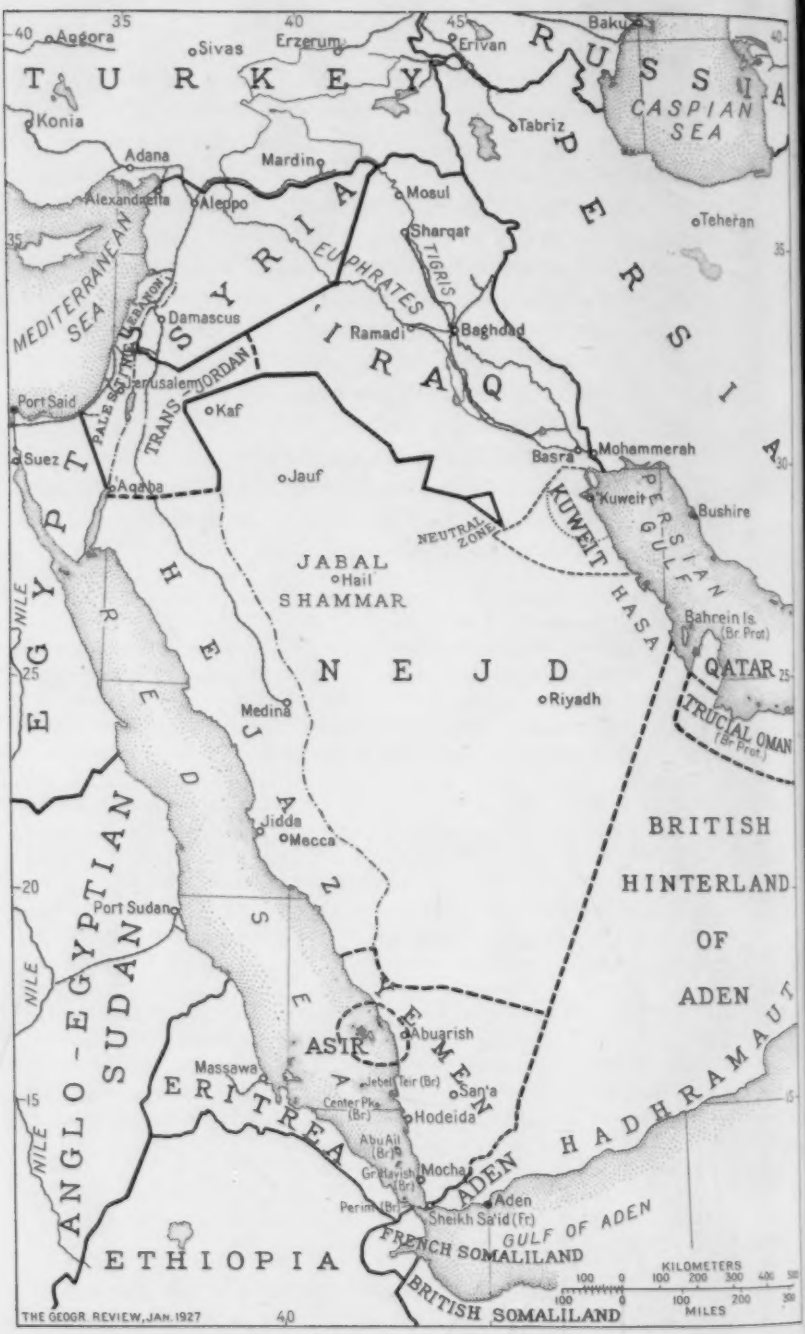

FIG. 1—Map showing the boundaries of the Nejd and adjacent countries. Scale, 1: 19,500,000. The northern boundaries of the Nejd are drawn in accord with Figure 2, otherwise the map follows that of Colonel Lawrence Martin in *Foreign Affairs*, July, 1926, p. 680. The heavy lines show international boundaries, solid where the line is determined, broken where undetermined. The dot-and-dash lines show internal boundaries.

supreme importance of desert watering places. Articles 2 and 3 of the protocol appended to the Mohammerah Agreement read as follows:

> Article 2. Whereas many of the wells fall within the 'Iraq boundaries and the Najd side is deprived of them, the 'Iraq Government pledges itself not to interfere with those Najd tribes living in the vicinity of the border should it be necessary for them to resort to the neighboring 'Iraq wells for water, provided that these wells are nearer to them than those within the Najd boundaries.
>
> Article 3. The two Governments mutually agree not to use the watering places and wells situated in the vicinity of the border for any military purpose, such as building forts on them, and not to concentrate troops in their vicinity.

It was soon found that the agreements had to be carried further because of the special problems of administration created by the migratory habits of frontier raiding tribes.[3] By the terms of the Bahra Agreement of November 1, 1925, the two governments mutually undertake to use all the means at their disposal other than expulsion and force to prevent unauthorized migration across the frontier. Raiding by tribes across the frontier zone into the territory of a neighbor is recognized as aggression subject to severe punishment. A special tribunal is provided to inquire into the particulars of aggression, assess the damages and losses, and fix the responsibility; and the decisions of the tribunal shall be final and executory. Tribes subject to one of the governments may not cross the frontier into the territory of the other government except by permit if the migration of the tribe is due to the necessities of grazing.

Of the same sort as the foregoing agreements is that made between the governments of the Nejd and of Trans-Jordan, the Hadda Agreement of November 2, 1925. Permits, conditions of migration, display of flags by sheiks of tribes, raiding and tribunals to deal with questions of aggression and damage are treated along similar lines. In this part of the boundary some particularly interesting questions arise.

The northerly extension of the Nejd in the region of Kaf at the eastern border of the Trans-Jordan country represents an intense conflict of tribal interests in which Ibn Saud came off victor. The real struggle between him and the British negotiators centered upon the Wadi Sirhan, which extends between Kaf and Jauf. The recent conquest of Jauf by Ibn Saud placed his tribesmen at the entrance of Wadi Sirhan, and he contended for the possession of the whole of it. It happens that the principal Trans-Jordan tribes use the wadi in the winter and spring, moving northward to the Damascus region in the summer. An effort was made to keep Ibn Saud out of the Wadi Sirhan, not merely for the protection of these tribes but also because the depression is largely frequented by the Ruwala nomads, who occupy the region through which runs the route from 'Iraq to Syria.

[3] See Report . . . on the Administration of 'Iraq for the Period April, 1923–December, 1924. [British Colonial Report] *Colonial No. 13*, 1925, pp. 42–51.

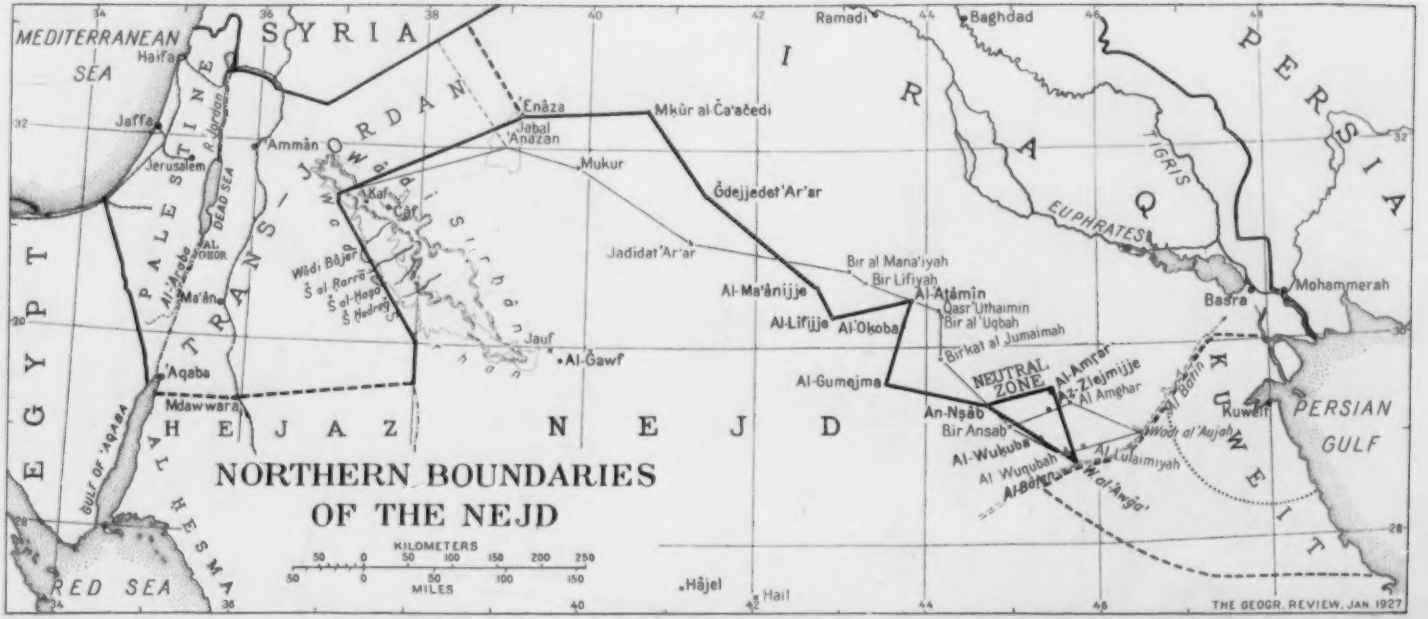

FIG. 2—Map showing the northern boundaries of the Nejd. Scale, 1: 8,250,000. There are considerable discrepancies in the charted positions of places in Arabia. The 'Iraq-Nejd boundary is defined by natural features, consequently its course varies according to the map upon which it is plotted. The Trans-Jordan-Nejd boundary, while defined in mathematical terms, also carries reference to certain natural features. The heavy line shows the boundaries as plotted on Professor Alois Musil's map of Northern Arabia, 1: 1,000,000, accompanying the account of his explorations in Arabia and Mesopotamia (1908–1915) now in course of publication by the American Geographical Society. Musil's rendition of Arabic names is shown in heavy lettering. The light line shows the boundaries as plotted on the International Millionth Map (Basra and El Djauf sheets) which was used in drawing up the Mohammerah Agreement. Rendition of the Arabic names in the treaty is in hair-line lettering. Attention is called to discrepancies in position of Jabal 'Enâza (Anazan) and especially to the Wadi Sirhan. Musil's version of the Wadi Sirhan is shown by a hachured border: the Millionth Map version by a fine dotted line. The four important wadis entering the Sirhan from the west are according to Musil. Were the Millionth Map version followed these wadis would be west of the Nejd-Trans-Jordan boundary as described in the treaty. The treaty in assigning the whole of the Wadi Sirhan to the Nejd further makes allowance for the "projecting edges" cut by the mathematical line on the base of the Millionth Map. [Note: in the Neutral Zone for Al-Wukuba read Al-'Okoba and for Ad-Dlejmijjât read Ad-Dlejmijjât.]

The southern boundary of Trans-Jordan has not been delimited, because of unstable conditions in the northern districts of the Hejaz. The broken line shows what appears to be the accepted British view of this boundary. The boundary between Trans-Jordan and 'Iraq also has not been delimited: the broken line shows the provisional boundary for administrative purposes.

In the case of Kuwait the dotted line shows the arc of 70 miles radius, the dashed line the sphere of influence of 1913. However, Philby in the Encyclopædia Britannica, 13th edition, Supplementary Volume I (dated Sept. 1, 1926, under Arabia-Kuwait, p. 154) states that the Kuwait boundary was agreed upon in 1921. His map credits Kuwait with a somewhat smaller area and shows another neutral zone in southern Kuwait.

This British corridor between Palestine and 'Iraq is regarded as of much importance. Through it runs the Imperial Air Route to the East. It is probable that an oil pipe line will be laid from Mosul to Haifa and possibly a Baghdad-Haifa railroad may be constructed.

Kaf is an extremely important strategic outpost of the Trans-Jordan country from which Ibn Saud could launch attacks upon the Trans-Jordan tribes and settlements and propagandize at will among the Ruwala. In addition to the Wadi Sirhan are the four wadis Bayer, Gharra, Hasa, and Hedrej. These lie east of the Damascus-Medina, or Hejaz railway, as it is called, and the tribesmen who occupy them range eastward partly into the Wadi Sirhan and partly westward up to and even across the railway. Some of them, as, for instance, the Jawazi section of the Huwaitat, winter in the Ghor (the deep depression partly occupied by the Dead Sea and the River Jordan) and in the continuation of this depression southward toward the Gulf of 'Aqaba known as Al 'Araba. As finally drawn, the boundary runs in such a manner as to include the Hejaz railway in the Trans-Jordan country, and it also leaves the four wadis just mentioned in the Trans-Jordan but cuts off the more easterly summer grazing grounds of the tribesmen, swings around Wadi Sirhan, and puts in the hands of Ibn Saud a valley upon which he can base attacks upon both the railway and the country west.

Texts of Agreements

The following description and interpretation of the texts of various agreements relating to the boundaries of the Nejd has been made with the assistance of Colonel Lawrence Martin, Chief of the Division of Maps of the Library of Congress. Professor Alois Musil has given help in the construction of the map of the northern boundaries of the Nejd.

The Sultanate of Nejd includes the formerly independent Kingdom of The Hejaz and the Amirate of Jabal Shammar, as well as parts of El Hasa, Asir, and Yemen, etc. Its boundaries are as follows:

I. *On the northwest and west*, with Trans-Jordan, for which Great Britain is Mandatory [the boundary is described from east to west to south]:

(1) "The frontier between Nejd and Trans-Jordan starts in the northeast from the point of intersection of meridian 39° E. and parallel 32° N., which marks the termination of the frontier between Nejd and 'Iraq, and proceeds in a straight line to the point of intersection of meridian 37° E. and parallel 31° 30′ N. and thence along meridian 37° E. to the point of its intersection with parallel 31° 25′ N. From this point it proceeds in a straight line to the point of intersection of meridian 38° E. and parallel 30° N., leaving all projecting edges of the Wadi Sirhan in Nejd territory, and thence proceeds along meridian 38° E. to the point of its intersection with parallel 29° 35′ N." [From the *Hadda Agreement*, Nov. 2, 1925, between the High British Government and the Sultan of Nejd and its Dependencies, "Agreements with the Sultan of Nejd Regarding Certain Questions Relating to the Nejd-Trans-Jordan and Nejd-'Iraq frontiers," Cmd. 2556, 1925, Article 1, page 3.]

13th edition, Supplementary Volume I (dated Sept. 1, 1926, under Arabia-Kuwait, page 126) that the sphere of influence of 1913. However, Philby in the Encyclopaedia Britannica, with a somewhat smaller area and shows another neutral zone in southern Kuwait. 1845 states that the Kuwait boundary was agreed upon in 1921. His map credits Kuwait

(2) From the point at the junction of the meridian of 38° E. and the parallel of 29° 35′ N. the boundary is understood to extend westward to the Hejaz Railway at Al Mudawwara and thence due west to a point on the Gulf of 'Aqaba south of the port of 'Aqaba.

(3) The remainder of the western boundary of Nejd is the Gulf of 'Aqaba and the Red Sea.

II. *On the north*, with 'Iraq and the Neutral Zone [the boundary is described from east to west]:

"The frontier from the east begins at the junction of the Wadi al 'Aujah (W. el Audja) with Al Batin, and from this point the Najd frontier passes in a straight line to the well called Al Wuqubah (El Ukabba), leaving Al Lulaimiyah (Dulaimiya) and Al Wuqubah (El Ukabba) north of the line, and from Al Wuqubah (El Ukabba) it continues N.W. to Bir Ansab (Bir Unsab).

"Starting from the point mentioned above, i. e. from the point of the junction of the Wadi al 'Aujah (W. el Audja) with Al Batin (El Batin), the 'Iraq boundary continues in a straight line N.W. to Al Amghar (El Amghar), leaving this place to the south of the line, and from thence proceeds S.W. in a straight line until it joins the Najd frontier at Bir Ansab (Bir Unsab).

"The area delimited by the points enumerated above which includes all these points will remain neutral and common to the two Governments of 'Iraq and Najd who will enjoy equal rights in it for all purposes. [This zone contains many wells.]

"From Bir Ansab (Bir Unsab) the boundary between the two States proceeds N.W. to Birkat al Jumaimah (Birkat al Djumeima) and from thence northwards to Bir al 'Uqbah (Bir el Akaba) and Qasr 'Uthaimin (Kasr Athmin), from there westwards in a straight line passing through the centre of Jal al Batn (Djal el Batn) to Bir Lifiyah (Bir Lifa) and then to Bir al Mana'iyah (Bir el Maniya) and from there to Jadidat 'Ar'ar (Dja-daidat el Arar), from there to Mukur, and from Makur to the Jabal 'Anazan (Anaza), situated in the neighbourhood of the intersection of latitude 32° (east-north) with longitude 39° (north-east) where the 'Iraq-Najd boundary terminates." [From the *Mohammerah Agreement*, May 5, 1922, Treaty and Undertakings in Force Between the Government of 'Iraq and H. H. The Sultan of Najd, Protocol No. 1 of Dec. 2, 1922, Article 1.]

III. *On the northeast and east*, with the Sultanate of Kuweit and the Persian Gulf.

"In the Anglo-Turkish Convention of 1913 the area under the direct control of the Shaikh of Kuwait had been defined on the map by a red circle with a radius of some 70 miles from Kuwait on all sides, while a farther area, from Umm Qasr to Al Ratk, thence down the Batin to Hafar and eastward to the Persian Gulf which it reached at Jabal Manifah, some 200 miles south of Kuwait was recognized as being within his sphere of influence." [Rept. on 'Iraq Administration for the period October 1920–March 1922.]

IV. *On the south*, with the British hinterland of Aden, and the Imamate of Yemen:

(1) "In April, 1905, after demarcation of the frontier [of Aden], Ottoman and British Commissioners signed an agreement which determines the boundary of the hinterland from Sheikh Murad on the Red Sea to Bana river, and thence north-east to the great Desert. By the Anglo-Turkish Convention of 1914, the boundary was prolonged through the desert to a point on the coast opposite Bahrein in the Persian Gulf." [The Statesman's Year-Book, 1926, p. 92.]

(2) The eastern boundary of Yemen is entirely undefined. The map, Figure 1, shows a conventional boundary based upon all available data as to which sheikdoms and villages pay tribute to and acknowledge the Imam of Yemen and which the Sultan of Nejd.

THE PROBLEM OF COAST PROTECTION

Douglas W. Johnson

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EVERY winter the public press records ravages effected by storm waves on one or more parts of our exposed coast. Now it is New Jersey which is the victim, with board walks and boulevards undermined and costly summer residences and big hotels destroyed. Again Florida is the sufferer, and columns of print are required to chronicle the devastation wrought by wind and sea along the margins of the land of fruit and flowers. The Galveston disaster is still fresh in memory. At one time or another the ocean takes toll of every coastal state from Maine to Texas and from southern California to the northern shores of Washington.

The problem of coast protection is becoming more acute every year. The automobile is bringing the population of the interior to the seashore in ever increasing crowds, property values along the sea are mounting rapidly, and demands for good bathing beaches are forcing municipalities to expend millions to preserve present beaches from destruction or to create new beaches where naturally only mud flats or jagged rocks were found. Unfortunately efforts at beach formation and coast protection have too frequently proved of little effect.

Coöperative Study and Action Necessary

Only through coöperative studies extending over a long stretch of sea front can there be collected a large body of carefully observed facts from which may be disengaged the general principles controlling coast erosion. Shore processes are peculiarly complex. Wave action varies with the strength of the wind, with the direction from which it blows, with the extent of open water over which it passes, with the depth of the water, with the form of the sea bottom, with the shape of the shore line, with the direction of tidal or other currents, with the height of the tide, and with other factors. Current action is similarly variable. At no two places on the coast do natural forces operate in precisely the same manner; and seldom, if ever, do they behave twice in precisely the same manner at any given point.

Coöperation in the work of designing and constructing coast defenses is equally necessary. The writer has elsewhere described the damage wrought on well protected property where the waves "outflanked" the defenses by first attacking unprotected areas on either

side.[1] On the shore every man is his neighbor's keeper. Even the man back of the shore is vitally concerned in the matter of coast protection, for he must pay, in the form of increased taxes, for every foot of land conquered by the sea. The city, the county, and the state are interested parties, since they all suffer when land and buildings are destroyed, just as they gain when shore resorts become great contributors to their wealth. The federal authorities are concerned; for, even if it should ultimately be decided that coast protection is a duty of state governments rather than of the federal government, it must always remain true that the United States Coast and Geodetic Survey, the United States Army Engineers, and other federal organizations will be among the most important agencies engaged in studies of coastal phenomena and coast-protection devices.

The Asbury Park Meeting

For several years the Committee of Shoreline Investigations of the National Research Council has been working toward this end and has brought about significant coöperation of federal, municipal, and private agencies in the study of certain specific questions.[2] On the 14th and 15th of last October, a step of unusual importance was taken at Asbury Park, N. J., when there was held the first conference of federal, state, and municipal authorities for the discussion of coast erosion and protection. The conference was called on the initiative of Commander R. S. Patton of the Coast and Geodetic Survey, the present chairman of the Committee on Shoreline Investigation named above and actively associated with the New Jersey Board of Commerce and Navigation. Invitations were issued to the coastal states by Governor Moore of New Jersey. Every state on the Atlantic Coast, except one, and two Gulf Coast states responded by sending delegates.

The meeting was devoted mainly to informal discussions of coastal problems in different states by the delegates, under the chairmanship of J. Spencer Smith, president of the New Jersey Board of Commerce and Navigation. The general trend of the discussions laid emphasis on the facts presented in the first part of this paper. Among the interesting details brought out, several deserve special mention. Federal improvements at the mouth of the Savannah River, at the Delaware Breakwater, and elsewhere have been followed by damage to adjacent coastal areas, this damage being attributed by some to changes in the equilibrium of shore forces consequent on the improvements. Wrightsville Beach, N. C., an incorporated town with a winter

[1] D. W. Johnson and W. S. Smith: Recent Storm Effects on the Northern New Jersey Shoreline and Their Supposed Relation to Coastal Subsidence, *Geol. Survey of New Jersey Bull. 12*, 1914, pp. 27–44.
D. W. Johnson and W. S. Smith: Wave Work on the New Jersey Coast, *Popular Sci. Monthly*, Vol. 86, 1915, pp. 557–567.

[2] Some account of the work of this Committee will be found on another page of this issue of the *Geographical Review*.

population of 22 persons and a summer population of 5000, spent $30,000 three years ago building wooden jetties to check erosion; those lasted but a short time, and another $30,000 has since been spent in building concrete jetties. At Stamford, Conn., a public park was made by filling sand over peat bog at a cost of $500,000, while a bathing pavilion was erected at a cost of $125,000; retreat of the shore line is placing the pavilion in danger of being undermined, and the need of protective measures is urgent. At a single point on the New Jersey Coast $350,000 was spent on shore protection to little effect, as storm waves soon destroyed the protective works. Extensive improvements at Coney Island have included the creation of a new beach by artificial sand deposition on a grand scale, with results thus far generally good, although replacement of eroded sand on part of the beach has been necessary. At Atlantic City jetties constructed on an extensive scale have given satisfactory results, much land having been added to the beach front where the checking of longshore currents has caused sand deposition. Excessive damage at Long Beach, N. Y., has resulted in contracts being let for 51 jetties and in the floating of a bond issue of half a million dollars, 40 per cent of the cost to be assessed on ocean-front property holders, 60 per cent on residents back of the beach. On part of the Massachusetts coast $250,000 has been spent in protecting a water front of eleven miles. Mississippi is meeting the problem by the issue of $3,400,000 in bonds for coast-protection works and by building what is said to be the longest concrete sea wall in the world; fourteen miles are already completed, and the finished wall will have a length of 24 miles.

The major result of the meeting was a resolution looking forward to the creation of an association of the states adjacent to the Atlantic and Gulf coasts for a concerted coöperative attack upon the problems of common interest. A first step in this direction was the appointment of an Executive Committee constituted as follows: J. Spencer Smith, chairman; R. S. Patton, U. S. Coast and Geodetic Survey, secretary; and one member from each of the following groups of states—Maine to Connecticut inclusive, New York to Virginia inclusive, North Carolina to Florida inclusive, Alabama to Texas.

This Executive Committee met at Norfolk, Va., on October 20. It perfected plans for a permanent organization, drafted a constitution and by-laws, determined upon the permanent committees to be set up, and proceeded to the selection of personnel for such committees. Before these pages go to press, all the steps indicated will have been submitted for ratification to a meeting of the association called at Washington, D. C., on December 8 in the building of the National Research Council. One of the most encouraging features about the whole effort is the rapidity with which progress is being made, a hopeful indication of real public earnestness.

DE FILIPPI'S EXPLORATIONS IN THE HIMALAYA, KARAKORAM, AND CHINESE TURKESTAN: A REVIEW

DE Filippi's remarkable explorations in the mountains and plateaus between the Vale of Kashmir and Chinese Turkestan were carried out in 1913–1914, but owing to the war the published results have been appearing only during the last four or five years. These publications, though they are not as yet complete, have progressed far enough to give us an idea of the extraordinarily comprehensive work accomplished. It is probable that no exploring expedition by land outside the polar regions has ever been so elaborately equipped or carefully planned or has yielded such a harvest of scientific results. That this was possible was due partly to the leader's talent for organization and partly to the material aid received from the Italian Government, the Government of India, the Royal Geographical Society of London, and other institutions in the form both of funds and of loans and gifts of instruments.

Sir Filippo De Filippi accompanied the Duke of the Abruzzi on the latter's expeditions to Mt. St. Elias, Ruwenzori, and the Karakoram. While working up bibliographical data in connection with his narrative of the Duke's Karakoram expedition, De Filippi tells us that he became aware of "the variety and the importance of the problems as yet unsolved" which the region about the upper Indus and upper Yarkand Rivers offered to the explorer. Thus originated the plan for his own expedition. But unlike the Duke, who was primarily interested in exploratory mountaineering as a sport, De Filippi was concerned first and foremost with scientific exploration; hence a distinguished group of scientists was invited to make up the party.

Geodetic, astronomical, geophysical, and topographical work was carried out by (naval) First Lieutenant (now Captain) Alberto Alessio and by Professor Giorgio Abetti of the University of Rome. Professor Giotto Dainelli of the University of Pisa and the late Professor Olinto Marinelli of the University of Florence devoted themselves to geology, geography, and anthropology. Dr. Camillo Alessandri, Director of the Monte Rosa Observatory and meteorologist of the Hydrographic Office in Venice, and the Marchese Nello Venturi Ginori specialized in meteorology and related studies. The Trigonometrical Survey of India was represented by Major (now Lieutenant Colonel) Henry Wood and by an engineer, Mr. J. A. Spranger, assisted by two Indian surveyors. Lieutenant (now Major) Cesare Antilli was in charge of photography. An Alpine guide, Giuseppe Petigax, who had also accompanied the Duke of the Abruzzi, rendered valuable services on the glaciers.

Route of Expedition

Leaving Srinagar, Kashmir, on September 21, 1913, the party crossed the main range of the Himalaya by the Zoji La and arrived at Skardu in Baltistan on October 25. On traversing the Himalaya they entered a country which had been visited by not a few earlier European travelers but one in which relatively little scientific exploration had been carried out on a comprehensive scale either as regards natural history or human geography. Consequently, De Filippi and his associates proposed not merely to examine a narrow band along the caravan route from India into Central Asia but rather, by taking plenty of time and by sending out side parties, to

explore as much as possible of the entire tract lying between the Karakoram and Himalaya and extending southeastward to the Tibetan borderlands. Thus, while some of the party remained at temporary headquarters established at Skardu taking gravimetric, astronomical, and meteorological observations, Dainelli made long excursions through the valleys south of the Karakoram glaciers. Other travelers have stressed the difficulties of winter journeys among these bleak highlands. Dainelli tried the experiment of winter traveling and found that his movements were facilitated rather than hindered by the frozen rivers and snow-covered ground.

On February 16, 1914, the party as a whole left Skardu and proceeded up the valley of the Indus to Leh, the capital of Ladakh, which was reached on March 26. While preparations were being made here for the summer campaign to the north, Dainelli visited the remote and lofty Rupshu plateau lying some eighty miles to the southeast. After the main party had been joined by Marinelli, Alessandri, Wood, Spranger, and the two Indian surveyors—who had not taken part in the work accomplished up to that time—, it left Leh on May 15 and made its way across the Chang La and through the upper Shyok valley to the desolate upland of Depsang. Here, at an altitude of 17,590 feet, not far south of the famous Karakoram Pass and within view of the easternmost glaciers of the Karakoram Range, a temporary base was established, at which during two and a half months, Alessandri and Venturi Ginori took frequent meteorological observations (hourly, during July). From this base Dainelli and Marinelli visited the upper valley of the Karakash River to the east, while Wood and Spranger were making a careful survey of the Depsang upland and neighboring valleys and Alessio and Abetti were busy with gravimetrical and astronomical work.

The main phase of pioneer exploration was carried out during July and early August among the eastern glaciers of the Karakoram and between these and the caravan route over the Karakoram Pass. This region had previously been mapped only very sketchily; the De Filippi expedition showed that earlier ideas regarding it were entirely erroneous, especially as relating to the main line of the continental divide between the watersheds of the Indian Ocean and the interior basin of Chinese Turkestan. The De Filippi expedition made the striking discovery that, whereas the three main arms of the great Remo glacier contribute to the Shyok and thence to the Indus, a branch leading out of the northern arm gives rise to the headwaters of the Yarkand. The Remo glacier thus lies astride the divide.

On August 16, three days after the whole expedition was reunited at the base camp, news was brought by couriers from India of the outbreak of the World War. This necessitated the immediate return of Alessio, Antilli, and Alessandri. The others proceeded northward, crossing the Karakoram Pass together but subsequently dividing and making their way to Karghalik in the lowland of Turkestan in separate parties and by various routes, the details of which we need not specify. From Chinese Turkestan the return to Europe was accomplished over the Pamirs and thence by way of the Transcaspian and Transcaucasian railways.

Published Results

The outstanding publications relating to the expedition consist of a monumental series of official reports and two popular books—all in Italian. The work carried out by the British detachment under Colonel Wood is narrated in English in a volume published in 1922 by the Trigonometrical Survey of India.

The scientific reports of the expedition's work are to be embodied in thirteen magnificent volumes, comprising two series. The first series, edited under the direction of De Filippi himself, will consist of three volumes: Vol. 1, "Astronomia geodetica, geodesia e topografia"; Vol. 2, "Geofisica: gravità e magnetismo"; and Vol. 3, "Geofisica: meteorologia." Of this series the first volume only has as yet

been published. The second series, on geology and geography, is being edited under the direction of Professor Dainelli and will comprise ten volumes, of which three have appeared to date: Vol. 1, "Storia dell'esplorazione: itinerari e ricerche"; Vol. 2, "Le serie dei terreni"; Vol. 3, "Studi sul Glaciale" (published in 1922); Vol. 4, "Le condizioni fisiche attuali"; Vol. 5, "I fossili del Paleozoico"; Vol. 6, "I fossili del Mesozoico e del Terziario"; Vol. 7, "Le rocce"; Vol. 8, "Le condizioni delle genti" (published in 1924); Vol. 9, "I tipi umani" (published in 1925); Vol. 10, "Raccolte di piante e di animali. Indici analitici." These publications show every evidence that the care both for detail and completeness which went into the organization and equipment of the expedition is also being devoted to the presentation of its results. These volumes, as well as De Filippi's popular narrative (noted below) are being published by Nicola Zanichelli, Florence.

Geodetic Astronomy and Topography

Volume 1 of the First Series is due to the coöperative enterprise of Abetti, Alessio, Antilli, Spranger, Venturi Ginori, and Wood. It opens with a brief prefatory narrative of the expedition as a whole by De Filippi himself. This is followed by full expositions of the astronomical position finding, the triangulation, the barometric and boiling point determinations of altitude, and of the photographic work accomplished. The illustrations show the instruments used and methods of carrying them, as well as the trigonometric, radio, and barometric stations set up; they also include outline diagrams of the various triangulation nets. The work described was carried on with a double end in view, partly for the positive facts to be derived from it and partly for its experimental value. No accurate triangulation had hitherto been made either of the main chain of the western Himalaya or of the eastern Karakoram. In establishing fixed points for the benefit of more detailed future topographical surveys, the expedition was performing a pioneer service, from which the geophysicist and geologist as well as the topographer of the future will benefit. The region is one of active tectonic movements: these can be detected and measured only when positions and altitudes have been ascertained with precision. The experimental aspect of the work, however, was of no less significance. This was one of the first expeditions in which the reception of wireless time signals was used as a basis for position finding. The relative degrees of accuracy attainable by the use of different methods and different types of instrument and the absolute degree of accuracy that may be achieved by a party working under particularly trying conditions of weather and terrain were held to be eminently worth finding out for their own sake if for no other reason. The expedition aimed to set a high standard of performance in the field.

Glaciology

In Volume 3 of the Second Series Professor Dainelli gives a detailed study of the glacial history of the Upper Indus watershed and the Vale of Kashmir. The scattered and uncoördinated observations of earlier travelers had failed to present an adequate view of the extent of the Quaternary glaciation in these regions. Indeed, the opinion prevailed that while the Quaternary glaciers were somewhat larger than those of the present day, the Indus valley itself was free from ice. Professor Dainelli discusses critically the published views of others in this regard, comparing them with the results of his own observations. His general conclusion is that land forms directly attributable to ice action are represented throughout the upper Indus valley above Skardu and provide indubitable evidence of extensive glacial erosion and deposition. There were, apparently, four main glacial stages. During the first two the Indus valley itself was occupied by a valley glacier formed by the combined glaciers coming down the side valleys from the Himalaya and Karakoram. During the third and fourth stages, though the Indus valley was not actually occupied by ice, it was

modified by the accumulation of lacustrine and fluvial deposits associated with an expansion of the glaciers in the neighboring mountains. The Indus valley appears to have been dammed near Skardu by the tongue of a side valley glacier, and a long lake was thus created, stretching for a distance of over 130 miles. The volume concludes with a treatment of the glacial beds and lake levels in the Vale of Kashmir. A separate volume of photographs and maps accompanies the text.

Human Geography

Professor Dainelli is no less competent in the field of human geography than in that of physiography. Volumes 8 and 9 of the Second Series supply us with the results of his very thorough investigations of man in the parts of Kashmir lying in the watershed of the upper Indus. Dainelli's personal observations are particularly valuable in this respect, because, unlike previous travelers, he did not hesitate to avail himself of native hospitality whenever possible. By actually staying in native dwellings he was enabled to learn much of local customs and character that would have been overlooked by the traveler who kept to his own tents. Dainelli correlates his personal observations in every case with what other travelers have written about the region. A critical examination of the results of the census of 1911 is made the basis for much of the demographic material in these two volumes.

Volume 8, "Conditions of the People," is primarily a monograph in anthropogeography. Two main topics are dealt with: the character of settlements (including lines of communication) and the distribution of peoples and of different kinds of cultivations. In his treatment of the character of the settlements Dainelli aims to work from the least to the most complex aspects of the subject. The human habitation being the fundamental unit of settlement, he first discusses house types. These, he finds, seem to fall into several well differentiated groups, each with a clearly defined area of distribution. The simplest habitation of all is the tent of the Changpà nomads of the great plateaus of western Tibet and eastern Ladakh. The houses of the Changpà who have adopted an agricultural régime and established permanent dwellings still retain some of the characteristics of the tent. In general, however, the Tibetan house type prevails, although the dwelling of the Buddhist Ladakhis is more closely related to the typical Tibetan house than that of the Moslem Baltis. The latter is usually ruder and less comfortable and would seem to represent a modification of the Tibetan form under the influence of climatic, economic, and cultural conditions.

The centers of population are not as distinctive in their grouping and internal arrangement as are the house types in their form. In general the former may be classified as either minor centers, predominantly agricultural, or major centers, with bazaars and, hence, of some commercial pretensions; but of the second type there are only six examples in the entire region studied.

Settlement follows the principal drainage lines. The mountain ridges and lesser valleys are utterly barren, uninhabited wastes. In the sense that they are isolated from each other by desert mountains and inhospitable stretches of valley, the settlements of Baltistan and Ladakh may rightly be called "oases." Agriculture depends entirely on irrigation. As the natives have not been able to devise means of raising water from the rivers to fields lying at higher elevations than the stream channels, irrigation for the most part is possible only on the alluvial cones built out by tributaries into the valleys of main streams. On these cones cluster the houses of the isolated "oases."

The upper limits of settlement are determined mainly by climatic and physiographic conditions. Dainelli has attempted to draw a contour map (p. 177) showing the upper limit of permanent settlement throughout the region. In general this rises as one approaches the Karakoram and as one goes southeastward toward the plateaus of Tibet. The highest permanent settlement in the whole region is at the Garzok-

Gompa (monastery) on the Rupshu Plateau, at an altitude of 15,040 feet. Dainelli states that this is the highest settlement in the world where there are fixed houses inhabited by non-nomadic families among cultivated fields. Parenthetically it may be noted that the highest permanent habitations of a pastoral people would seem to be at an elevation of 17,000 feet and more (Isaiah Bowman: The Andes of Southern Peru, *Amer. Geogr. Soc. Research Ser. No. 2*, 1916, p. 52).

The population of the region, as a whole, has been gradually increasing of late years. Dainelli's discussion of the density of population in relation to twenty-five natural regions into which he subdivides Ladakh and Baltistan is of value both for the light which it sheds on existing conditions and as a contribution to the methodology of the geographical study of population. Our only regret is that for the two maps showing densities of population the colors and tints were not better selected to bring out gradations from less to more thickly settled areas. Besides dealing with the distribution of individuals, Dainelli gives an extensive and illuminating treatment of the distribution of house types, centers of population, religions, languages, social statuses, agricultural enterprises, and vegetation types.

In Volume 9 Professor Dainelli turns from anthropogeography to ethnology: from the discussion of the distribution of human phenomena to a discussion of the people themselves and of their social and religious institutions. These folk fall into several groups, of which the Baltis and Ladakhis are the most important numerically. Between the Baltis and Ladakhis live the lesser intermediate groups, Puriks and Makhnopa (or "Indus Dards"); west of the Baltis dwell the Brokpa, or Dards; and east of the Ladakhis the Changpà nomads occupy the upper Indus valley as winter headquarters, wandering widely upon the neighboring wind-swept plateaus in the summer. The essential differences between the Baltis and the Ladakhis Dainelli believes should be attributed to their religions, the Ladakhis being Buddhist, the Baltis Mohammedan. To this difference Dainelli would ascribe the very marked divergences between these people in culture, art, and character. The Baltis are polygamists, the Ladakhis polyandrists. Whether or not the latter became polyandrous through the compulsion of environmental forces, as some have claimed, Dainelli believes that to polyandry may be attributed their superior prosperity. In a polyandrous society the number of families is fixed and the population as a whole remains stationary, even though individual families may be large. The Ladakhis build better houses, are more cheerful, more adventurous, more open to suggestion, and on the whole more "civilized" than their Moslem neighbors.

The last part of the ninth volume is an analysis by Professor Renato Biasutti of 408 somatic observations made by Dainelli.

Popular Narratives

Before closing, a word must be said of the two popular books dealing with the expedition. The first to appear was the delightfully written personal journal of Professor Dainelli entitled "Paesi e genti del Caracorùm" and published under the auspices of the Reale Società Geografica Italiana in 1924. Since much of Dainelli's work was done apart from the rest of the expedition, these volumes do not cover the same ground as that covered by De Filippi in his "Storia della spedizione scientifica italiana nel Himàlaia, Caracorùm, e Turchestàn Cinese" (1913–1914). The latter is a beautiful piece of work both from the literary and typographical points of view. Dainelli and Spranger contribute chapters on phases of the exploration with which they were connected. Writing in clear attractive style, the authors give enough incident and color to make a thoroughly absorbing story; at the same time they furnish sufficient scientific detail and argument to familiarize the reader with the more important constructive results of the expedition. The volume is fully illustrated with maps and photographs (including many panoramas) and with two exquisite reproductions in color of landscape paintings.

AMERICAN GEOGRAPHICAL SOCIETY

The November Meeting. The first regular meeting of the American Geographical Society for the season 1926–1927 was held on November 23, 1926, at the Engineering Societies Building, 29 West 39th Street, President John H. Finley in the chair. Dr. Knud Rasmussen spoke on "Across Arctic America," honoring the Society by making this his first public appearance in America. In a series of still and moving pictures he traced the route of the Fifth Thule Expedition, in which he and two Eskimo companions traveled by dog sledge for 10,000 miles along the northern coast of North America, visiting almost every known tribe of Eskimo. A preliminary report on the expedition appeared in the October, 1925, number of the *Geographical Review:* a detailed narrative account under the title "Across Arctic America" is now in press and will be reviewed subsequently in the *Geographical Review.*

In opening the meeting, President Finley referred to the presentation of the Charles P. Daly Medal of the Society to Dr. Rasmussen at Copenhagen in 1925, through the kind offices of the American Minister, Dr. Prince. In addition President Finley took occasion to present the medal of the League of Walkers to Dr. Rasmussen and to say that it was struck in gold for the first time in honor of his extraordinary journey. A duplicate was handed the explorer for presentation by him to Arnarulunguaq, the Little Woman, who accompanied him throughout his journey and who, after the return of the expedition, resumed her place in the Eskimo settlement at North Star Bay, Greenland.

Elections to Fellowship. At the November meeting of the Society, President Finley presiding, there were presented with the approval of the Council the names of 520 candidates who were duly elected as Fellows of the Society.

Distribution of Title Page, Contents, and Index of Vol. 16 of the Geographical Review. The title page, table of contents, and index for Volume 16 of the *Geographical Review* (1926), which is issued separately, will shortly be ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

Presentation of the David Livingstone Centenary Medal to Luis Riso Patrón. The presentation of the David Livingstone Centenary Medal for 1925 to Dr. Luis Riso Patrón took place on September 14, 1926, at the American Embassy, Santiago. The reception tendered on the occasion was attended by the Minister of Foreign Affairs and other officials of the Foreign Office, members of the Diplomatic Corps and scientific circles and leading members of the American colony in Santiago. The ceremony was arranged by Chargé d'Affaires C. Van H. Engert. In making the presentation he spoke in part as follows:

"The American Geographical Society, in conferring this medal upon you, Dr. Luis Riso Patrón Sanchez, has borne in mind your many claims to special distinction in the field of exploration and geographical research: the fact, for example, that you headed the first Chilean Commission to make an accurate survey of the Cordillera de los Andes; that you explored hitherto unknown parts of the Lago San Martin region; that you conducted surveys of the Chile-Argentine and Chile-Bolivian boundaries; that you have edited topographic maps of these boundaries as well as the Chilean sheets of the International Map of the World; and that you are the author

of the monumental Geographical Dictionary of Chile and of other important books and articles too numerous to mention on the Cordillera and on the history of exploration in the Americas.

"I deem it a great privilege indeed to present to you this gold medal on behalf of the American Geographical Society not only in recognition of your great merits as a scholar but also, I know, as a token of the high esteem in which you are personally held by your many friends in the United States."

In accepting the medal Dr. Riso Patrón expressed his appreciation of the award and of the occasion on which it was presented. He concluded with a plea "for development of geographical study and national cartography which themselves more than repay any sums that may be devoted to the purpose."

Recent Publications

China: Land of Famine. "It is a shocking fact that with all the labor expended and virtues practiced, nearly a fourth of the people of the globe live in a land of famine—not of general famine at any one time nor of continuous famine in any one place but of famine in one or another province or locality all the time" says President Finley in his foreword to Mr. Walter H. Mallory's book "China: Land of Famine," *Special Publication No. 6*. Mr. Mallory, who has had experience in relief work in many lands, has just completed five years service as secretary of the China International Famine Relief Commission. In this volume he gives his analysis of the problem, its causes and cures.

The book begins with a consideration of the economic conditions under which the people live. "Even in a normal year the bare food requirements are not met." Natural phenomena, the floods and droughts for which the plain of eastern China is notorious, precipitate serious states of famine. The political chaos under which the country is now suffering by its wasteful demands on resources and its neglect of famine-prevention measures, aggravates the evil. Back of all lies the fundamental cause, "a density of population greater than the land is able to support," a consequence of the high birth rate and the reluctance of the people to leave their ancestral homes. To change the customs and beliefs which are at the bottom of the multiplying force must be a slow process, such is the innate conservatism of the Chinese. But certain cures can be applied which will yield immediate results. In order of practical importance Mr. Mallory lists flood control, irrigation, and land reclamation; economic improvements, rural credit, colonization, and home and village industry; improved agriculture and forestation; development of transportation; and education (in the sense of book learning).

The volume is illustrated with over 90 photographs and 12 maps, as well as plans for flood control and land reclamation.

Peopling the Argentine Pampa. Professor Mark Jefferson was leader of the American Geographical Society's Expedition to South America in 1918. Study of modern colonization in Argentina, Brazil, and Chile was the prime purpose of this expedition. Results published heretofore include *Research Series Nos. 6 and 7*, "Recent Colonization in Chile" (1921) and "The Rainfall of Chile" (1921), and "Pictures from Southern Brazil" (*Geogr. Rev.*, Vol. 16, 1926, pp. 521–547). The present volume, *Research Series No. 16*, is a detailed and intimate study made possible by the additional basis of the author's residence in the Argentine from 1883 to 1889.

The historical and geographical setting is first laid before the reader. The Pampa is described before its transformation from a vast cattle range to an agricultural land at the hands of the immigrants. The essential contrast with the irrigated valleys of the west is pointed out. The beginnings of the immigration movement and its growth under the trend of political events follow in outline. The first agricultural

colony, Esperanza, was established in Santa Fe in 1856. The history of this and other colonies of Santa Fe and Entre Ríos, successful and unsuccessful, is told in succeeding chapters largely by sketches of the personal history of families, that is in the terms of actual events, not of decrees or arrangements on paper. Obstacles in the way of satisfactory fulfillment of the colonization movement are pointed out in the chapter entitled "The Railroads and the Transformation of Agriculture." Immigration has developed the railway net and raised land values enormously; it has created the billion dollar grain and cattle exports, making the Argentine the business nation of South America, doing half the trade of the continent with one-seventh of the population; it has brought wealth to the Creole landowner. But the landowner has become correspondingly reluctant to part with his land. Today half the fertile land of the Pampa is occupied by the vast estates of cattle-raising Creoles: further progress rests in their hands. What a complete opening up of the country to colonization would mean is told in the final chapter, "Immigration as an Asset to the Argentine."

The volume is illustrated with 55 photographs and 13 maps and diagrams. Special mention may be made of the insert map, Plate I, showing stages in the growth of cities and railroads.

The Northern Ḥeğâz. As already announced in the *Review* (Vol. 15, 1925, p. 297) "through the interest and generosity of Charles R. Crane, Esq., the Society is enabled to edit, publish, and distribute the results of thirty years' study of Arabian geography and history" on the part of Professor Alois Musil of Prague, "of which fourteen years were spent in the field." Professor Musil's work will be published in six volumes as the first contribution of the Society's new series, *Oriental Explorations and Studies*. The first volume, "The Northern Ḥeğâz" (Hejaz), is now ready for distribution.

The main part of the volume consists of the narrative of a journey carried out in 1910. Leaving Ma'an on May 23, Professor Musil first visited an encampment of the Hwetat Bedouins in the desert some thirty miles east of the Hejaz Railway. Thence he proceeded to 'Aqaba by way of the Shera range and al-Homeima. From 'Aqaba he visited the ruins at the site of the ancient Madian (or Midian), going thence to Tebuk by way of Sharma. After a short sojourn at Tebuk he explored part of the *harra*, or lava-capped plateau to the south, touching the upper course of Wadi al-Jizel and returning along the railway line to Tebuk, which was reached on July 6. The return journey thence to Syria was made by rail.

The vivid narrative of events day by day is broken by detailed descriptions of the topography of the regions traversed, based upon the personal observations of the author and the examination of many natives. These topographical digressions serve in large measure as the explanation for a map (1:500,000) which accompanies the volume, the only detailed map of this little-known region in existence. As appendixes and footnotes there are full discussions of the Biblical, Assyrian, Greek, Latin, and Arabic notices of the Northern Hejaz. Among other matters here discussed are the probable route of the Exodus and the location of the Midianite tribes and the homeland of Job. The volume is fully illustrated with photographs, maps, and diagrams.

Index to the Geographical Review, Volumes I-XV, 1916–1925. This index, compiled by Arthur A. Brooks, is an analytical guide to the contents of the *Geographical Review*, the journal of the American Geographical Society of New York, for the first ten years (fifteen volumes) of its publication, that is from 1916 to 1925 inclusive. It is the chronological successor to the "Index to the Bulletin of the American Geographical Society, 1852–1915," published in 1918. The index to the *Bulletin* covered a longer period, but the present index is fuller and more analytical.

In this index are included subjects and authors of leading articles, subjects and authors of notes, and titles and authors of books, articles, and maps reviewed.

Practical Hints to Scientific Travellers, Volume IV. "Practical Hints" is a series of guides edited by Dr. H. A. Brouwer, professor of geology at the Technical University of Delft. By arrangement with the publishers, Martinus Nijhoff of the Hague, the volumes are distributed to American readers by the American Geographical Society. Volumes I, II, and III were issued in 1925 (see *Geogr. Rev.*, Vol. 16, 1926, pp. 307–308). Volume IV is now available. Its contents are: Egypt by O. H. Little; Angola by F. J. Faber; Australia by Griffith Taylor, R. Lockhart Jack, H. Basedow, R. H. Cambage, and Marjorie J. Shiels; Antarctica by Griffith Taylor; Venezuela by E. A. L. Gevaerts; Haiti by W. P. Woodring.

GEOGRAPHICAL RECORD

NORTH AMERICA

Shore Line Investigations on the Atlantic Coast of North America. At the October meeting of the National Research Council's Committee on Shoreline Investigations special attention was paid to the question of change in mean sea level in relation to change in shore-line conformation. It is customary to regard mean sea level as a constant; and differences at different periods, if not due to errors of determination, have been ascribed to changes in the altitude of the land relative to the sea. Recent researches on the supposed progressive subsidence of the Atlantic coast, however, suggest the possibility of local fluctuations of the datum line. Apart from the effect on bench marks the question has an immediate practical bearing, for erosion is more vigorous on a sinking coast line: property values are affected, the need of protective works arises, and litigation not infrequently ensues.

In pursuance of this line of investigation the Committee plans study of tide gauges at critical locations. The Canadian Hydrographic Office has promised tentatively to undertake such work at St. John, N. B. Here a large embayment, Kennebecasis Lake, connects with the outer harbor by a narrow inlet; the embayment receives a large quantity of fresh water, and the tidal range is very great. Other prospective sites are on Jamaica Bay, where conditions afford an instructive contrast, the tidal range being moderate and the connecting channels fairly wide, and at Eastport, Me., site of a scheme for the utilization of tidal power.

Another phase of the Committee's activities is the accumulation of a record of coast changes, as full and complete as possible. Data on erosion and accretion and of man's intervention in protective and improvement works are sought. Photographic records are specially valuable. The Committee asks coöperation from all persons or organizations interested. Communications should be addressed to Commander R. S. Patton, U. S. Coast and Geodetic Survey, Washington, D. C., or Professor Douglas Johnson, Columbia University, New York City.

Civic Planning for the San Francisco Bay Metropolitan Area. The San Francisco-Oakland agglomeration is already one of the great metropolitan areas of the world. The population now reaches the million mark; the district limits embrace 448 square miles. All circumstances indicate continued growth. The situation is strategic with regard to world trade routes, and there is a rich hinterland; the site offers excellent harbor facilities and conditions for industry; the region has climatic and scenic attractions. Mr. Charles H. Lee forecasts for the future metropolis a population of 5,000,000 to 6,000,000 (The Future Development of the Metropolitan Area Surrounding San Francisco Bay, *Bull. Seismol. Soc. of Amer.*, Vol. 16, 1926, pp. 81–132). It will occupy an area of 3730 square miles; extending outward an average radius of 40 miles from the Ferry Building of San Francisco. This area includes much rough land, but the part capable of intensive use will be not less than 876,300 acres.

The future metropolis will find the chief limiting factor to future growth in the water supply question. The great metropolitan areas of London and New York with their eight millions of people are situated in lands of humid climate. San Francisco is on the semi-arid border line. The most recent rainfall map of California gives San Francisco 20 inches per annum for the 25-year period ending 1919–1920 (Burton M. Varney: Seasonal Precipitation in California and Its Variability,

Monthly Weather Rev., April, 1925, pp. 148–163), and the variability is considerable. The city's present requirements of 100 million gallons a day are met from local sources entirely. These, it is estimated, could be developed to 250 million gallons. But the requirements of the future metropolis are placed at 1075 million gallons and would call for full development of plans now under way or projected on the Sierra streams and Eel River projects and would also draw on the Sacramento-San Joaquin River.

In planning for water distribution as for other public utilities the metropolis faces a special problem in earthquake risk. The larger the city the more serious the problem. "The risk from earthquake shock in a great city grows not simply in proportion to the population, but in the ratio of some indeterminate, higher power of their number," says Professor Bailey Willis in an introductory paper to Mr. Lee's study. Proper planning can greatly reduce the hazard. The increase of local water storage capacity, the use of all feasible regional sites for reservoirs, interconnection of systems to meet emergencies, avoidance of fault lines as far as possible are some of the safeguards to be considered. The systematic establishment of open spaces to act as fire-breaks is urged, and the promotion of earthquake-proof construction.

FIG. 1—Sketch map of the San Francisco region. The present metropolitan area shown by a solid line; the future area by a dashed line. The shaded area is adapted to intensive use; the dotted area can be made so by drainage. Scale of map approximately 1:4,000,000.

The distribution of the land area of the metropolis in a great ring about San Francisco Bay has a controlling influence on population distribution. It suggests certain advantages for the future—that the area develop on a small-unit community plan rather than about a single geographical center—but at the same time the isolated units need to be brought together for their common interests. The building of trans-Bay bridges would be an important contribution to this end. The proposed bridges, however, should not supplant the existing ferry service, the means of transportation least likely to interruption as a result of earthquake damage.

Saline Lakes of the Mohave Desert. During the potash shortage created by the World War Searles Lake came into prominence as a producer and has continued to produce while the majority of domestic sources declined on reëstablishment of the European industry. Under improved methods the Lake product can meet the price of the imported article. An investigation into the Franco-German monopoly by the U. S. Department of Commerce (H. M. Hoar: Potash: Significance of Foreign Control and Economic Need of Domestic Development, *U. S. Dept. of Commerce, Trade Promotion Ser. No. 33*, 1926) states that the output from the lake for 1924–1925 covered about ten per cent of American potash purchases.

The surface salt crust of Searles Lake is 50 to 75 feet deep, and salts occur as deep as the deepest boring—over 600 feet. Formed by evaporation from a large saline lake under a combination of unusually favorable circumstances the deposit is unique in the Mohave Desert (William F. Foshag: Saline Lakes of the Mohave Desert Region, *Econ. Geology*, Vol. 21, 1926, pp. 56–64). Most of the superficial salt concentration of the region occurs as playa deposits. The playas, accumulating in the

lowest parts of the desert basins are classed as "dry" and "wet." The wet playas during the rainy season are generally occupied by shallow bodies of water and are more or less moist for the remainder of the year. The saline material is brought into the basins largely by underground circulation, and the salts reach the surface by capillary action. The saline concentration is mainly superficial. The dry playas, with surfaces of hard smooth sun-baked clay have no saline concentration. They are formed in non-water-tight basins where the water table is below the depth of capillary rise.

Some investigation of the desert playas has already been made in connection with the quest for potash. According to Mr. Foshag, "a critical study of the deposits would not only determine their possible importance as saline deposits, but also give much data upon the origin of the similar and perhaps much more important uplifted Tertiary lake beds which occur in the same general area" and which provide the chief source of the recent deposits.

Expeditions to the Gulf of California and the Islands West and South of Lower California. In 1921 the California Academy of Sciences sent a group of six representatives to study the fauna and flora of the islands in the Gulf and of localities on the adjacent mainland. Two representatives of the Museo Nacional of Mexico were commissioned to accompany the party. The expedition started from the port of Guaymas in April and, during the following three months, visited nearly all of the islands in the gulf and touched at many points along both coasts that are seldom reached by outsiders either from Mexico or abroad.

Reports from each group of scientists have been published. As an official publication of the Mexican government there has appeared a narrative of the expedition (Carlos López: Informe preliminar acerca de una expedición al Golfo de California, *Bol. Oficial Sec. de Agric. y Fomento*, Vol. 6, 1921, Nos. 9, 10, 11, and 12, pp. I–XXI). The American members of the expedition issued their reports including a "General Account" (Ser. 4, Vol. 12, 1923, No. 6) and technical papers in the *Proceedings of the California Academy of Sciences*.

Only a few of the islands were found to be inhabited either by whites or Indians. The Seri apparently use some of the islands, particularly the island of Tiburón lying just off the continental shore of Mexico, as hunting grounds though seemingly not for permanent residence. There is little to tempt anyone to live on these isolated bits of land or along these shores. In fact there is no water and little soil on many of the islands. A few pearl hunters are still seen, but that once important business is nearly at an end. At some of the small settlements along the coast fishing affords a meager living for part of the inhabitants. Distance from good markets prevents the development of this which would otherwise, perhaps, become an important industry. In a few places the extraction of salt from sea water constitutes a means of livelihood for a tiny colony. The only prosperous community encountered by the expedition, aside from the port of Guaymas on the eastern shore of the Gulf, was Santa Rosalia, where copper, mined in considerable quantities and smelted with coal brought on sailing ships, is exported from the artificially constructed harbor in sufficient amounts to form the basis of a comparatively thriving community of some ten thousand people. At the mouth of a few of the deep, narrow canyons that reach from the high interior of the peninsula to the west coast of the gulf, there is sufficient water, either surface or subterranean, to make possible attractive gardens and orchards of palms, figs, oranges, mangoes, and other tropical fruits; and in such spots the old Spanish towns of La Paz, Mulegé, and Loreto, founded long before Upper California was colonized, still drowse in the continuous heat that is supposed to have suggested the name for the peninsula when Cortés and his fellow discoverers first cruised along the shores of what at that time was thought to be an island.

In 1922, under the auspices of a "Committee on the Conservation of Marine Life of the Pacific" appointed by the Pacific Division of the American Association for the Advancement of Science and with the aid of several scientific societies and the National Government of Mexico, an expedition was undertaken to the islands off the west coast of Lower California. A general report of this expedition is contained in the *Proceedings of the California Academy of Sciences*, Ser. 4, Vol. 14, 1925, No. 12. A prime object was to secure data on the Guadalupe elephant seal, the Guadalupe fur seal, and the southern sea otter, all formerly abundant on the shores and islands of California and Lower California. While no examples of the two latter were found, the remnant of a herd of elephant seals was located and counted on Guadalupe Island, 150 miles off the mainland coast. As a result of the researches of the expedition, Mexico has declared Guadalupe Island a game preserve.

In 1925 the California Academy of Sciences organized an expedition to the Revillagigedo Islands. These are a group of four main islands, the largest of which, Socorro, lies some 260 miles west of south of Cape San Lucas. Guadalupe Island, the Tres Marias Islands, and the coast of Lower California were visited in addition to the Revillagigedo Islands. Although the islands visited are difficult of access, barren and unattractive to man, they were shown to be of great scientific interest. Plants and animal collections were made and geological and photographic studies carried out. Important topographic features, hitherto nameless, were named. The U. S. Geographic Board and the Government of Mexico have since approved these names. A general report of the expedition in narrative form appears in the *Proceedings of the California Academy of Sciences*, Vol. 15, 1926, No. 1.

GEORGE M. MCBRIDE

The Locust Plague in Mexico. The serious and general invasion of Mexico and her southern neighbors by locusts during the period 1923–1926 has attracted the attention of zoölogical workers throughout the western world. The state of Veracruz through the agency of the Comisión Científica Exploradora de la Plaga de la Langosta enlisted the services of Dr. Carlos C. Hoffmann who gives the results of his survey of the situation in *Memorias y Revista Soc. Científica "Antonio Alzate"* (Vol. 44, 1925, pp. 191–227).

The group of Acrididae to which the locust in question (*Schistocerca paranensis Burm.*) belongs is a very ancient and firmly established one in South and Central America. The particular species is distributed geographically from about latitude 44° S. to latitude 25° N. It is a truly tropical species, very sensitive to changes in environment and showing definite moisture requirements for its survival. It is not known to invade the United States.

As in the case of the migratory locusts of the old world, *Schistocerca paranensis* has two distinct forms. One of these is primitive and non-migratory, and the other represents the well known pest, the migratory form. In its permanent habitats the non-migratory form does not originate migrating swarms, as these regions consist of "biologically balanced areas." It has been shown that the migratory form of *paranensis* requires a loose, moist soil for successful oviposition and multiplication. This is believed to be furnished in the silt deposited by the periodical inundation of river banks and benches on the edges of the permanent habitats when conditions favorable to multiplication have continued for some time. The subsequent desiccation, or perhaps the excessive locust population, of such inundated areas stimulates migration. Upon reaching cultivated lands the migrants find soils and conditions ideal for rapid multiplication, thus originating plagues. In Veracruz these begin in the tropical lowlands and progress from southeast to northwest, gradually approaching the mountainous highlands where the outbreaks eventually die out. In the meantime, however, there may be numerous return flights of adults

from the highlands to lower elevations. This is in marked contrast with the habits of the species in the Argentine where enormous flights over wide areas from north to south and return are the rule. The marked vertical variation in climate obtaining in Veracruz has facilitated the environmental studies.

In the temperate sections there are but two generations annually, but there may be four in tropical areas. The latitudinal limit of the movements of the swarms of young hoppers in Veracruz is 19° N.; the altitudinal, 1600 meters above sea level. The tropical part of the state forms the true center of the plagues, which are believed to originate in Guatemala; at least they enter Mexico from that country either from the Lake Peten region or to the southward thereof. The author believes the "Peten zone" to be of great importance and that a thorough study of this and similar regions would do much to solve the problem of locust invasion and perhaps permit the discovery of effective control measures. In this work the coöperation of neighboring republics would be a necessary concomitant.

It is apparent, in view of the present comprehensive studies of Dr. Hoffmann and his colleagues and those recently made in the Argentine and Bolivia, that the fundamental data for a complete understanding of the migratory locust problem in Central and South America may soon be available and give hope of the practical solution of this long-standing and important problem.

W. R. WALTON

SOUTH AMERICA

The Rains and Floods of La Libertad, Peru, in 1925. Reference has been made in preceding numbers of the *Geographical Review* to the abnormal rains and resulting damage on the Peruvian coast in 1925, and one phase of destruction is illustrated in this number by Major Holstein who writes of the ancient ruins of Chan-Chan near Trujillo. A fuller discussion of the effects of rains and floods in the department La Libertad, of which Trujillo is capital, is given by Señor Jorge M. Zegarra, chief of the Technical Commission of Irrigation (Las lluvias y avenidas extraordinarias del verano de 1925 y su influencia sobre la agricultura del departamento de La Libertad, Lima, 1926).

Normally the rains of the north Peruvian coast are limited to a few showers of short duration generally falling during the summer months, January–April. Thus the average annual rainfall of Trujillo for 1918–1924 (Hacienda Herederos, a short distance east of the city) is given as 4 millimeters; for a station in the lower Chicama valley 22 millimeters is the average for a five-year period. In the Sierra rains are heavier, and the annual floods in the streams provide water for irrigation (see Fig. 4, p. 39). The upper Chicama basin is credited with a yearly rainfall of about 600 millimeters. In the summer of 1925 Trujillo had some 400 millimeters; a station in the upper Chicama valley 1400 millimeters. The most serious damage was done by the floods. The four major streams of the department, the Jequetepeque, Chicama, Moche, and Virú, have average maximum discharges of 200–250, 350, 150, and 75 cubic meters a second respectively. All gauging stations were swept away by the floods of 1925, but estimates place the discharges of these four streams at 480, 1200, 800, and 800 cubic meters a second respectively. The coastal quebradas normally dry carried much water; the Rio Seco of Huanchaco, for instance, emptying directly into the sea, was discharging at the rate of 300 cubic meters a second on March 24.

The town of Chicama was practically destroyed; Virú was partially destroyed and communications seriously disrupted. Thanks to early preventive measures Trujillo escaped the menace of the Moche. The most important question for the inhabitants of the region, however, was the effect on agriculture. The Department has some 45,000 hectares (over 110,000 acres) under cultivation in the four valleys;

over half the total in the Chicama valley, nearly one-third in Jequetepeque. The sugar and rice crops of Chicama are valued at over 2,500,000 Peruvian pounds, the rice and cotton of Jequetepeque at nearly 500,000 Peruvian pounds. The floods broke down irrigation channels and covered fields with sand and gravel. The sucrose content of the sugar cane is also said to have been unfavorably affected. On the other hand the land benefited by the exceptional watering. Two sugar estates have already reported larger yield; and in particular great benefit, which will redress the losses from the drought of 1923–1924, is expected for subsequent rice crops in Jequetepeque. Señor Zegarra thinks the balance is favorable to agriculture.

A Remarkable Population Forecast in the Argentine. In 1872 Diego G. de la Fuente, reporting the results of the First Argentine census, that of 1869, estimated the population of the Republic for the ensuing fifty years with an accuracy as astonishing as the wildness of our own census estimates.

He had gathered up all the earlier *estimates* of Argentine population, the values for the years 1809 decennially to 1859 being respectively 406, 527, 634, 768, 935, and 1304 thousands of persons. His census for 1869 gave 1,736,923. He calculated from these values decennial percentages of increase of 30, 20, 21, 22, 39, and 33, only the last two being free of the incubus of the tyrant Rosas. Then he turned to the censuses of the United States from 1790 to 1860, noting increases of 35.02, 36.45, 33.13, 33.49, 32.67, 35.87, and 35.57 per cent, an average of 34.6 per cent. From his opinion of the capacity of his country to maintain population and from these two histories of the past he judged that the population of the republic was going to increase for many years at the rate of 36 per cent a decade. That gave him for the dates 1879 to 1919 respective values of 2464, 3444, 4778, 6591, and 9057 thousand persons.

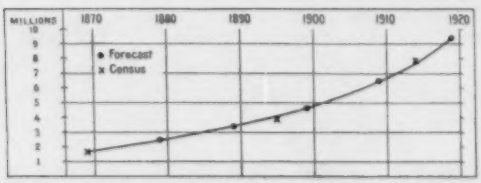

FIG. 1—Estimated growth of population in the Argentine Republic, shown by a curve (Primer censo de la República Argentina verificado en los dias 15, 16, 17 de Setiembre de 1869, Buenos Aires, 1872, p. xxii) compared with actual census values, shown by crosses.

As a matter of fact the figures of the two censuses taken since his day fall almost exactly on the figures of his estimates—in 1895, 3,954,911; in 1914, 7,885,237—as is seen on the accompanying diagram. Either he was lucky or his method is a sound one.

MARK JEFFERSON

EUROPE

Is Britain Overpopulated? Among the findings of the Royal Commission on the Coal Industry (1925) (Report, Vol. 1, London, 1926) is one of great interest to students of population problems. The conclusion is drawn that the coal industry is overmanned and "is too large in size for the requirements it has to fulfill" (p. 230). Even if labor is transferred from low grade to high grade collieries, even if wages are lowered and a still lower standard of living enforced, there remains the question as to whether the coal business can continue to maintain its present proportions.

In a spirited article on the British population problem as a whole, Professor Thompson draws some alarming conclusions (W. S. Thompson: "Britain's Population Problem as Seen by an American," *Econ. Journ.*, Vol. 36, 1926, pp. 177–191). He believes that the general falling off in purchases from Great Britain since the war is not merely a post-war episode or a passing phase of the business cycle but

represents a new alignment of the world's industrial power in which Great Britain will continue to suffer unless her industrial population is in part turned out upon the land. By an analysis of the several parts of the British Empire from the industrial standpoint he finds such a growth of local or regional industries as to threaten continued decline of imports from the mother country. Statistics bearing on the point are given from Australia, Canada, and South Africa. Outside the Empire the situation is the same. Only in South America does the field still look favorable.

To Russia, Britain exports only one third as much as in pre-war years. British exports to Germany in the five years 1919–1923 were less than one quarter of what they were in 1909–1913. The industrialization of India and China, though only begun and even though moderate in its scope, still represents a serious invasion. By contrast, the exports of the United States and of Japan have vastly increased with the increase of their merchant fleets, and Canada and Australia have taken an independent attitude toward the development of their foreign trade. Professor Thompson does not see in the development of tropical peoples much relief for Britain, because their capacity to absorb imports is very small and tropical agriculture as a whole does not lend itself to extensive machine methods of tilling. He points to the nine per cent of people in Britain engaged in agriculture and believes this to be dangerously small or that the proportion engaged in industry and commerce is dangerously large. He concludes with a special warning to the United States to learn from the present plight of Britain and study the means of avoiding it by promoting agriculture as the basic condition of a balanced national life.

A New Rainfall Map of the Iberian Peninsula. A detailed map of precipitation in the Iberian Peninsula for the five years 1916 to 1920 has been prepared by Señor Pedro M. González Quijano (La lluvia en la Península Ibérica durante el quinquenio de 1916–20, *Rev. de Obras Públicas*, No. 2428, May, 1925). There are 961 stations of reference, all with more than a year of record, while 376 have the five years complete, except perhaps for a month or two. Short-period series have been reduced to the mean by multiplying by a factor obtained from a group of stations near, on the assumption of proportionate rainfall. Some stations whose values came out discordant when thus reduced have been rejected.

An interesting key map shows the distribution of stations by the drawing of circles of ten-kilometers radius around each. It would have been well, in addition, to have put a distinct dot at each point of observation. The striking feature of the distribution is the paucity of Portuguese measurements. The east and south of Spain seem fairly well provided with stations, as if people took most interest in rainfall where they lacked it, for that part of the peninsula is distinctly semi-arid.

The defect of the map is the shortness of the record on which it is based: the five years might, of course, fall in a wet period or a dry period. To check up on this, Quijano has listed the normal values of annual rainfall for 36 older stations alongside the means for this pentad, with the quite astonishing result that exactly half the stations have "normal" means larger than the pentad means, the other half smaller! More than that, the mean of the pentad values is in round numbers 613 millimeters, of the "normal" values 618. Individual values, it is true, have differences that seem more credible; Caceres, 468 pentad, 751 normal; Murcia, 280 and 537; Orense, 916 and 700; Santiago, 1438 and 1655; and Santander, 1189 and 839. Quijano draws from this comparison what he is careful to call the "simple impression" that the decade was a rather dry one.

Isohyetals are drawn for every 100 millimeters. We reproduce in Figure 1 the lines for 500, 1000, and 2000, giving side by side the same lines from Reger's map of 1903, "Regenkarte von Europa" (*Petermanns Mitt.*, Vol. 49, 1903). It ought to be noted that the values Quijano gives in his table of comparisons for the 36 points do not agree very well with his isohyetal lines: there are several instances of dis-

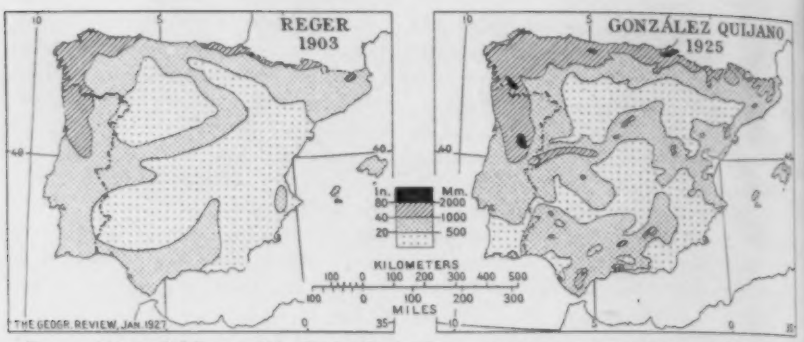

FIG. 1—A new rainfall map of the Iberian Peninsula compared with an earlier interpretation. Scale of maps approximately 1: 23,500,000.

crepancies of 50 millimeters or more. The differences do not appear to result from misregister of the red isohyetal lines on the black base, for they all come nicely to the coast. Apparently the lines are drawn without the precision that should accompany so minute a grading of rainfall values.

In general the new map gives Spain and Portugal more rain than appeared on Reger's map. Quijano thinks the whole peninsula has an average of 680 to 700 millimeters: Spain alone would have 649 and Portugal 837—a little more than Angot estimates for France on more complete data. But the form of the distribution is little changed, heavy rains in the north and northwest, a belt of 500-millimeter rain across the peninsula from southwest to northeast, with pockets of scanty rainfall on either side. The northern pocket of lighter rainfall on Reger's map was an interior area, mostly to the northwest of Madrid. Now this is extended almost across the peninsula to Tarragona. The southern area of drought formerly was represented as reaching to the Mediterranean almost from Málaga to Barcelona, with a slight interruption along the eastern end of the Sierra Morena. It is now interrupted in a number of places, and the mountains of the south show four areas with over a meter of rain. As is always the case with increasing data the isohyetals have become much more intricate in their pattern than we were wont to draw them. But a five-year period is very short.

MARK JEFFERSON

AFRICA

Changes in Egyptian Agriculture. The national revenue of Egypt is estimated at £E300,000,000 a year. About half this sum is derived from landed property, of which over two-thirds is from crops. The proverbial fertility of her soil is still the chief asset of the country. It has been maintained through centuries by the nice adjustment of cultivation to physical conditions. But of recent years methods have changed: what of the ancient fertility? Some crops have shown a decline in yield in the last two decades. The problem is discussed by Victor M. Mosséri, technical adviser to the Royal Agricultural Society of Egypt, in the *Compte Rendu* of the International Geographical Congress, held at Cairo, 1925 (La fertilité de l'Égypte, Vol. 4, pp. 135–168). An English summary appears in the *International Review of the Science and Practice of Agriculture*, January–March, 1926). In earlier studies M. Mosséri had demonstrated that one of the chief factors in the renewal of the Egyptian soil was the annual period of fallowing, the *charaqi*, from May to September. During the hot, dry summer soil temperatures of 55°–70° C. are ex-

perienced. The tenuous soil, with its high percentage of colloidal clay, shrinks and cracks. Cracks, in fact, may occupy as much as 35 per cent of the surface. Among the beneficial results of the cracking process are a sterilization of the soil from weeds and parasites, removal of excess salts, aëration, increased permeability and porosity—in other words, the effect secured by careful cultivation. After the *charaqi* the basins formerly were inundated from the Nile flood waters and later sown to winter crops.

Today perennial irrigation has replaced the old basin system over four-fifths of the cultivated area. Summer crops can now be grown. A new biennial rotation

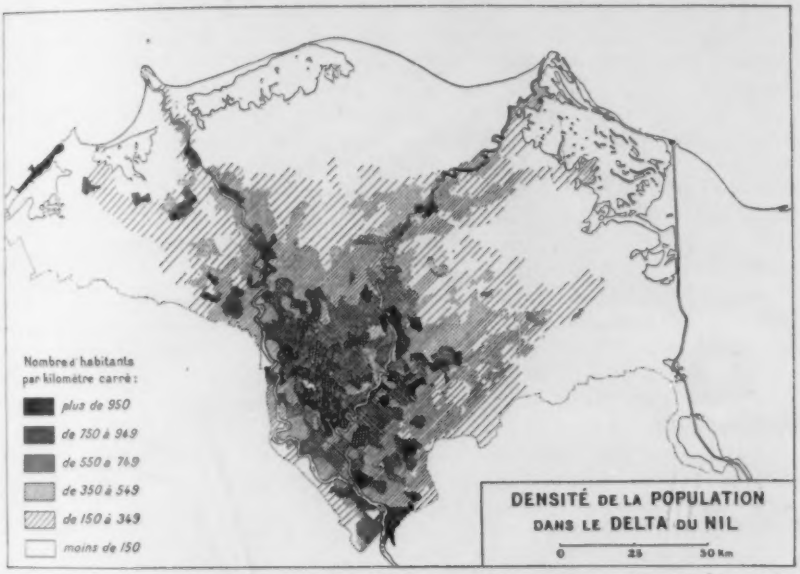

FIG. 1—Map showing the high density of population in the Nile Delta, reproduced by permission from the map by V. M. Mosséri in the *Annales de Géographie*, Vol. 25, 1926, p. 167.

has sprung up in which the *charaqi* period has been greatly curtailed, in particular by what M. Mosséri calls the "excessive expansion of cotton growing."

The recent changes in the agricultural economy of the country are discussed by M. Demangeon in the *Annales de Géographie* for March, 1926. By the side of the traditional harvests are vast acreages of other crops—bersim, cotton, maize. Bersim (Alexandrine clover), a forage and fertilizing plant, has assumed great importance. It occupies more than a fifth of the cultivated area, as much as cotton, more than wheat, a little less than maize. Sugar cane occupies less than one per cent of the area; but the conditions under which it has been established, the modern equipment and processes used, present an interesting contrast with the primitive agriculture existing side by side.

The new crops, entailing more work, more implements, the use of commercial fertilizer, new needs of water, raise the question of the laborer: has the *fellah* too changed? Not as much as one might imagine, says M. Demangeon, and the prime reason lies in the very great density of population. The *fellahin* cling to the soil: the majority now are peasant proprietors, and the land tends towards minute subdivision. In 1896 there were 767,000 landed proprietors, whose holdings averaged 6 feddans (a feddan is a little more than an acre); in 1924 there were 1,972,365 proprietors, whose holdings averaged 2.9 feddans.

One change in the conditions of rural life to which M. Demangeon calls special attention is the movement from the crowded village agglomeration to the isolated farm, *ezbeh*, a movement encouraged by the new methods of agriculture and similar to the movements towards dispersion in various agricultural lands of western Europe.

ASIA

The Bakhtiari Tribes of Southern Persia. The interesting mountain tribes of southern Persia, the Bakhtiaris, formed the subject of a recent lecture by Sir Arnold T. Wilson (*Journ. Central Asian Soc.*, Vol. 13, 1926, pp. 205–225). The lecture was illustrated by the remarkable film "Grass" which Fellows of the American Geographical Society will recall was shown by Mr. Merian Cooper at the Society's meeting in January, 1925 (see also Mr. Cooper's book "Grass," New York and London, 1925).

Many theories as to the origin of the Bakhtiaris have been formulated. Recent research into tribal legend and tradition suggests that under this collective name are grouped refugee tribes from a half dozen races now absorbed into the original Iranian stock. Today two main divisions of the tribes are recognized, the Haft Lang and Chahar Lang. The majority of the Haft Lang are nomadic and in the course of their seasonal migrations cover all the central part of the tribal territory, wintering in the low hills and valleys fronting the plains of Arabistan, summering in the lofty central ranges and hill plains on the border of the central Iranian plateau. They also practice agriculture to some extent. Many tribes raise two crops of grain during the year. On the uplands the grain is sown in the autumn and reaped in the succeeding summer. In the lowlands the winter planting is harvested by members of the tribes left behind at the spring exodus—an inverse, one might say, of the practice in transhumance.

The Chahar Lang, now numerically inferior, occupy the southeastern part of the tribal territory where they are more or less sedentary and the northern and western frontiers where they are nomadic.

On the Palisade in Manchuria. While most of the contributions that have so far appeared in the *Japanese Journal of Geology and Geography* (National Research Council of Japan) are geological, note may be made of a paper under the above title by Professor Hiroshi Satô of the Tokyo University of Commerce (Vol. 3, 1924, No. 3–4, pp. 167–178). The Palisade is an extension of that most famous artificial boundary, the Great Wall of China (see map in F. G. Clapp: Along and Across the Great Wall of China, *Geogr. Rev.*, Vol. 9, 1920, pp. 221–249). From better-preserved portions of the western section some idea may be gained of the construction, which was apparently a dike topped by a stockade of willows and moated on the outer side. It was built in the seventeenth century as a defense and a protection for colonists in the extreme northeastern part of the Manchu domain. The western section of the Palisade, 500 miles in length, starts at the Great Wall 15 miles north of Shanhaikwan and runs northeast terminating beyond the Sungari River north of Kirin. The eastern branch, 260 miles in length, starts northeast of Kaiyüan, runs southeast along the divide between the Liao and Sungari, then southwest along the western edge of the Yalu basin. The purpose of this branch was to demarcate the Imperial hunting grounds. In addition to the Palisade we have here on the right bank of the Yalu one of the classic examples of the waste-land frontier. In 1627, nearly 6000 square miles were set aside as a "no man's land" in which settlement was prohibited until as late as 1867, when it was opened by the Peking government to settlers from Shantung.

Today little survives of either feature. Of the eastern branch of the Palisade there is scarcely a vestige save some old village names. One souvenir remains, however,

in some of the towns of the region, which had their origin as boundary markets. Such is Changchun, west of Kirin. Thither comes a great part of the staples of Kirin and Amur provinces. From autumn to spring Mongolian products arrive by camel train, and fairs for grains and animals are held several times a year. Changchun now has important rail connections and has grown rapidly of late years. Like other towns of the region it has almost entirely lost its former Mongolian character.

Polar Regions

Fig. 1

Fig. 2

Fig. 1—The midnight sun at Selawik, Alaska, in June, at 20-minute intervals. Photograph by Mr. Sylvester Chance.

Fig. 2—The midday sun at Noorvik, Alaska, December 21, at 15-minute intervals. Photograph by Miss Alice Riner.

Refraction and Daylight in the Arctic. The accompanying photographs give a striking demonstration of the fact that it cannot be true, even in an approximate sense, that we have six months day and six months night at the North Pole. The photograph, Figure 1, is taken at Selawik, Alaska, near Kotzebue Sound and exactly on the Arctic Circle. It is taken practically from sea level, but the sun is obscured by a range of hills, the Kobuk Mountains, about 3000 feet high. The photograph shows plainly enough that the hills are higher than would correspond to a full diameter of the sun, and they make, therefore, a demonstration of what we know from theory, that refraction keeps the sun almost a degree above the horizon at midnight in summer and more than a degree above the horizon at midday in winter.

The photograph, Figure 2, is of the midday sun, taken on December 21, 1923, at Noorvik some fifteen miles north of Lake Selawik.

V. Stefansson

THE OCEANS

The German Atlantic Expedition. The South Atlantic and neighboring Antarctic was the field chosen for the first important German oceanographic expedition since the war. Under the scientific leadership of Dr. Alfred Merz of the Oceanographic Institute of the University of Berlin, the *Meteor*—a converted man-of-war—left Wilhelmshaven April 16, 1925, with a complement of experienced oceanographers aboard, the plan calling for approximately two years of intensive oceanographic investigations.

The program of the expedition is outlined by Dr. Merz in a paper entitled "Die Deutsche Atlantische Expedition auf dem Vermessungs- und Forschungsschiff 'Meteor'." (*Sitzungsber. Preuss. Akad. der Wiss., Phys.-Math. Klasse*, 1925, pp. 562–586). The principal question to be studied is the circulation of the water, both horizontal and vertical. This problem will be attacked directly and indirectly—directly by measuring the current at definite points in the ocean and indirectly by the application of the theoretical dynamic principles of Mohn and Bjerknes to the distribution of density and temperature. All factors entering into this question are to be studied quantitatively—density, temperature, bottom relief, rainfall, evaporation, and related chemical, physical, and geological features. For this purpose the expedition is fitted out with a full complement of modern oceanographic apparatus including four different types of echo or sonic sounding apparatus.

In his paper Dr. Merz discusses the present state of knowledge of the oceanography of the South Atlantic, directing attention to the fact that this knowledge is almost wholly of a qualitative nature. It is the aim of this expedition to derive quantitative data of a precise nature. To carry out the program outlined, fourteen cross sections or profiles between Africa and South America are planned with a number of stations across each of these profiles.

Early in June the systematic observations on the first of these profiles was begun, but after five stations had been occupied the work was interrupted by the illness of Dr. Merz. He was taken to Buenos Aires, and here on August 16, 1925, he died. The leadership of the expedition now devolved on Captain F. Spiess, Commander of the *Meteor*, and the work continued in accordance with the original program.

The first report on the progress of the work is given in two groups of eight papers each in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* (1926, pp. 1–77 and 209–274). These comprise preliminary reports on the results of the first three profiles and of the fourth and fifth profiles respectively, and consist of the report of the leader and reports on the oceanographic, biologic, geologic, acoustic, chemical, and meteorological investigations.

H. A. MARMER

WORLD AS A WHOLE AND LARGER PARTS

Government Intervention in the Export Trade of New Zealand and South Africa. New Zealand is aptly characterized as an "outlying farm or supply station for the Mother Country." In 1925 her export trade amounted to £55,200,000 the bulk of which represented pastoral products, chiefly wool, butter and cheese, and frozen meat. The total foreign trade for that year was £107,700,000. The per capita trade, like that of Great Britain, is abnormally large. With her prosperity singularly dependent on her exports New Zealand suffers the handicap of extreme remoteness. Her chief customer, Great Britain—taking 80 per cent of exports in 1924, is at the maximum distance. New Zealand has no shipping lines of her own, and there are particular difficulties in adapting to market fluctuations the primary production in which she is engaged. In the period of depression following the post-war boom she resorted to state intervention. The Meat Export Control Act was passed in 1922;

dairy produce and the minor fruit, honey, and kauri-gum industries followed suit. Shipment, freight, grading, insurance, and handling of the commodities are regulated, and the Dairy Board is assuming control of the selling end. The Meat and Dairy Export Control Boards between them govern nearly 95 per cent of the export trade (*The Round Table*, No. 64, 1926, pp. 877–888).

Fruit export from South Africa is a new trade developed in a generation in a comparatively new country. Climatically the African subcontinent is admirably suited to the growth of fruit in great variety; no less than 25 different kinds are now produced on a commercial scale. Home consumption is large, especially on the mining fields: and, with the exception of sugar, no exports in the last ten to fifteen years show relatively a growth anywhere near comparable. In 1923 fresh and dried fruit exports amounted to over three-quarters of a million sterling.

Fruits are classed as deciduous, chiefly pears, grapes, peaches, and plums, for which the season is from December–January to April–May and citrus, chiefly oranges, for which the season is May–June to September–October. In 1922–1923 over a million cases of deciduous fruits and 900,000 cases of citrus fruits were shipped from the Union. The methods of marketing this highly perishable product bear some resemblance to the coöperative measures adopted in California and Florida, but there are fundamental differences in the problem. The American commodity is mainly sent by rail from compact growing areas: the South African commodity is collected from a subcontinent into four outlets to be shipped thousands of miles by water. Government intervention was early sought: the first act of control being passed in 1914. In 1921 the Fruit-Growers' Coöperative Exchange was incorporated. By the Fruit Export Control Act of 1925 the export of fruit from the Union can be effected only through the Fruit Growers' Exchange, except for consumption in Rhodesia, the Protectorates, and the Belgian Congo. An amendment restricts shipment through Lorenço Marques via Komatipoort (Transvaal). Internal arrangements in the industry are now said to be in a satisfactory state; the outstanding problem is the provision of shipping accommodation for the anticipated export of six million cases of citrus fruit by 1930 (*The Round Table*, No. 62, 1926, pp. 417–426).

Geodesy and Cartography in Soviet Russia. The U. S. Coast and Geodetic Survey has received a communication from Dr. Jules Schokalsky, President of the Russian Geographical Society, telling of the first Conference of Geodesy, Topography, and Cartography of the Union of Soviet Socialist Republics, of which he also was president. The conference was held in Moscow in April, 1926.

The immediate result of the Moscow conference was the adoption of a set of resolutions in regard to the various surveying and mapping problems of the country, and it is hoped that there will follow the collection of accurate geodetic data, which in turn will be followed by scientific investigations, especially in regard to deflections of the vertical and values of gravity. It may be interesting to note that there has been great activity in Russia in recent years in connection with magnetic surveys, for it has been found that the magnetic needle can be used in searching for buried minerals having magnetic properties. A summary of the more outstanding features of the resolutions is given below.

It was decided that the existing scheme of triangulation is sufficiently precise to determine the elements of the terrestrial spheroid provided additional bases are measured and additional rounds of angles are taken on signals which are excessively high. The Bessel spheroid has already been used on much of the computation work and has been retained for the immediate future instead of the Hayford spheroid adopted as standard at the Madrid meeting of the International Union of Geodesy and Geophysics in 1924. It is intended to connect up the existing independent triangulations, especial attention being given to that along the 41st meridian in view of its great length and consequent importance as a factor in the determination of the sphe-

roid. To secure connection between Russian and foreign geodetic operations a scheme involving the coöperation of the Prussian Geodetic Institute was suggested.

Connections by precise leveling between the White, Black, and Baltic seas and the Pacific Ocean are to be completed. The zero of the Cronstadt gauge will continue to be taken as the initial datum point for heights throughout the country. It is proposed to construct two fundamental bench marks near Cronstadt on stable geological formations and to redetermine at fixed intervals their relation to the Cronstadt zero.

An urgent need is determination of the difference in longitude between Greenwich and Pulkovo. All available data will be examined to arrive at the most probable value. A longitude bureau attached to the Pulkovo observatory is proposed to work in close coöperation with the geodetic committee, collecting data and determining the differences of longitude between strategic points in the first-order triangulation both from the results of the trigonometrical operations and by absolute methods involving the use of wireless time signals. In connection with these latter, corrections for the time signals sent out by Pulkovo would be published.

It was resolved that the National Commissariats of Agriculture of the various republics in Soviet Russia should undertake their own local cadastral operations and develop detailed triangulation but that, in order that this work might be accomplished with sufficient precision, secondary triangulation and leveling should be undertaken by the state, thereby controlling all topographic work by geodetic operations. Emphasis was laid on the value of phototopography and aerial topography undertaken in conjunction with other surveying operations, and the need for instrumental research in this connection and for the manufacture in Russia of photographic supplies was stressed.

In considering the question of the standardization of map scales, it was decided to use in the future only scales suitable for use with the metric system. Those chosen were 1:5,000; 1:10,000; 1:25,000; 1:50,000; 1:100,000; 1:200,000; 1:500,000; and 1:1,000,000. Old maps on other scales should be kept up to date until replaced by the new ones. However, this standardization should not apply to hydrographic charts.

Participation by the Soviet in the International Millionth Map was recommended. The working out of a system of transliterating Russian geographic names into the Roman alphabet is being entrusted to the Russian Geographical Society.

The need for hypsometric maps on small scales and for magnetic charts was emphasized, as also the construction in Russia of geodetic and geophysical apparatus. Finally, it was resolved that the special map requirements of the geologist, the geomorphologist, and the geographer must be considered in formulating all surveying instructions.

PHYSICAL GEOGRAPHY

The Prediction of Tidal Waves. The so-called "tidal wave" which at times devastates coastal regions is in no way related to the tides. Occasionally it is the result of a severe storm, but generally it is brought about by seaquakes. In spite of its being a misnomer, the appellation has become firmly established and is more readily understood than the technically correct designation of seismic sea wave. Because of the suddenness with which it overwhelms the coast, the possibility of predicting the occurrence of a tidal wave is of great importance even if such prediction can be made only a few hours in advance of its occurrence.

Seismic disturbances are transmitted more rapidly through the solid earth than through the waters of the sea. For regions subject to tidal waves, therefore, the preliminary seismic waves recorded by a seismograph serve as an advance notice of the possible coming of a tidal wave. Such a method of prediction for Hawaiian

waters is outlined by R. H. Finch in a paper entitled "On the Prediction of Tidal Waves" (*Proc. Pan-Pacific Science Congress, Australia, 1923*, Vol. 2, pp. 1366–1368, Melbourne). Taking advantage of the fact that the time in minutes required by the first preliminary waves of a quake to reach a given point through the earth is very nearly the same as the time in hours required by the seismic sea wave, a table has been prepared showing the distance from Hawaii of most of the earthquake regions in the Pacific and the time required for a seismic sea wave from each region.

The author notes that it is usually impossible to make positive predictions of tidal waves from the seismograph records of but one station, for, even if the distance and general direction of the seismic disturbance are known, the distribution of land is such that there is nearly always a doubt as to whether the quake occurred on land or under the sea. It may be added, too, that apparently it is only the seaquake accompanied by subsidence of an area of the ocean floor that gives rise to tidal waves. But from the seismogram it is not yet possible to determine when such subsidence takes place, and therefore the seismic disturbances recorded by a seismograph indicate only the possibility of a tidal wave.

H. A. MARMER

GEOGRAPHICAL NEWS

Scottish National Memorial to David Livingstone. A movement is under way to establish a memorial to David Livingstone in his early home at Blantyre on the Clyde near Glasgow. It is proposed to purchase his birthplace, to put it into repair, and to endow it as a museum for available Livingstone relics and for other exhibits indicating the vast development in Africa subsequent to the great explorer's discoveries.

In connection it is of interest to recall President Daly's introductory remarks at the Livingstone Memorial Meeting of the American Geographical Society held on April 23, 1874. "The connection of Dr. Livingstone with the Society extends almost to the period when he commenced his career as an explorer. His name has been the longest upon our list of honorary members. . . . We had hoped . . . that we would have had the opportunity, upon some public occasion, of expressing to him our appreciation and that of the American people of what he had done in extending the boundaries of human knowledge, and in the great cause of humanity."

The committee in charge of the memorial appeals for a sum of £12,000. Subscriptions should be sent to the Hon. Treasurer, Mr. James MacGregor Hart, at 142 St. Vincent Street, Glasgow.

GEOGRAPHICAL REVIEWS

Ocean Studies

James Johnstone. **A Study of the Oceans.** viii and 215 pp.; maps, diagrs., bibliogr., index. Longmans, Green & Co., New York; Edward Arnold Co., London, 1926. 9 x 6 inches.

Franz Graf von Larisch-Moennich. **Sturmsee und Brandung.** x and 186 pp.; maps, diagrs., ills., bibliogr., index. (Monographien zur Erdkunde, No. 33). Velhagen & Klasing, Leipzig, 1925. 10 x 7 inches.

G. Clerc-Rampal. **La mer: La mer dans la nature, la mer et l'homme.** viii and 303 pp.; maps, diagrs., ills. Librarie Larousse, Paris, n.d. 13 x 9½ inches.

Edward H. Smith. **A Practical Method for Determining Ocean Currents.** vi and 50 pp.; diagrs. *U. S. Coast Guard Bull. No. 14.* Washington, D. C., 1924. 9 x 6 inches.

Gerhard Schott. **Geographie des Atlantischen Ozeans.** 2nd edit. xvi and 368 pp.; maps, diagrs., ills., bibliogrs., index. C. Boysen, Hamburg, 1926. 11 x 8 inches.

The domain of oceanography is so broad and covers so great a variety of matters more or less intimately related that various modes of approach, groupings of topics and methods of treatment are possible in ocean studies. Treatises or textbooks of oceanography are obliged to leave all but the more formal content of the subject outside their ken. As a consequence, interesting and illuminating collateral matters—for example historical background, interplay of economic and political motives in the advancement of oceanographic exploration—are left outside the scope of what is ordinarily presented as oceanography.

It is some of these neglected aspects of oceanography that Dr. Johnstone discusses in "A Study of the Oceans." This may be regarded as a companion volume to his "An Introduction to Oceanography" (reviewed in *Geogr. Rev.*, Vol. 15, 1925, pp. 173–174) in which a formal introduction to oceanography was presented. Properly to orient the reader, Dr. Johnstone devotes the first chapter of the present volume to a brief summary of the geological history of the ocean, in which the various hypotheses of the origin of the earth, age and permanence of the ocean, the origin of the continents and of the great earth features are discussed. The two following chapters deal with the classical geography of the ocean and with the crossing of the ocean in their historical setting. The next chapter takes up the circumpolar regions, and here the dramatic stories of the quest for the Northwest Passage and of the attainment of the North and South Poles are related. This in turn is followed by chapters on the Atlantic, Pacific, and Indian Oceans in which, in addition to the physical features usually dealt with, such matters as human races, prehistoric civilizations, cycles of civilization, and the lost Atlantis are discussed.

Dr. Johnstone in this volume draws on a number of specialized sciences—astronomy, anthropology, geology, history. It is obvious, therefore, that many controversial questions must be dealt with in a summary manner. Despite this and despite, too, the wide range of matters covered, the volume rarely becomes merely encyclopedic; on the contrary, it is very readable, the various matters touched on focusing always on the oceanic question under discussion. The short bibliography, however, entitled "Suggestions for Further Reading" might well have included

other than British publications, especially since no mention is made of the fact of such limitation.

In "Sturmsee und Brandung" Count Larisch deals with a single aspect of the ocean, the movement of the sea in response to the play of wind and weather. This is a subject beset with many difficult questions which frequently are discussed by means of mathematical formulae. In the present volume, however, the author sedulously avoids formal mathematics, having in mind the general geographic public rather than the specialist.

The subject matter is divided into three parts, the first of which, comprising about one-third of the volume, discusses the relations of wave to wind and the form of waves. The second part, constituting about half the volume, deals with the observed wave movements in the various oceans and seas. The author discusses the meteorological conditions and seasonal variations in the different oceans and the response in the movement of the waters. The third part is devoted to the varied phenomena of the surf caused by the breaking of the waves on different coasts and ends with a brief discussion of the work of the waves. The appended bibliography, comprising some thirty titles, lists the more important German, English, and French publications dealing with the subject matter.

Count Larisch discusses the subject of wave movement from the viewpoint of the observer and always with reference to its geographic setting. But he does more than this. He invests the subject with the feeling of the lover of the sea and brings to the reader something of the spirit of the restless waters in their varied moods—largely by means of the beautiful illustrations with which the text is embellished. One hundred and thirty-six photographs—all, it is of interest to note, the handiwork of the author—picture the sea in play and in anger throughout the world.

The scope of M. Clerc-Rampal's "La mer" is defined by its subtitle, the book being divided into two very nearly equal parts, the first dealing with "The Sea in Nature" and the second with "Sea and Man." Under the first heading the author begins at the very beginning of things and takes up in turn the generally discussed topics of the geography of the sea, the physical and chemical composition of its waters, its movements, oceanic life, ending with descriptions of the Museum of Oceanography at Monaco, the Oceanographic Institute at Paris, and several marine biological laboratories. In the second part, the author deals with the means employed in mastering the sea. Here are sections describing the development of the boat from the Egyptian galley to the modern leviathan and man-of-war, the sea fisheries with their varied activities, yachting, navigation, ports, and canals.

Obviously the volume is conceived on somewhat encyclopedic lines; and the topics throughout are handled descriptively. The various matters, however, are discussed without undue detail, and the interest is enhanced by a wealth of illustrations—nearly one thousand photographs, diagrams, and maps being included in the volume. One feature, however, cannot be commended. While no date of publication appears, there are references within the volume to dates as late as 1923, leading one to infer that the subject matter is treated in the light of knowledge at that time. But, as a matter of fact, this volume is in all essential respects exactly the same as the previous edition which, also without date of publication, appeared in 1913. The only differences are that here and there several sentences within a paragraph have been recast to permit the inclusion of a reference to "la guerre de 1914–1918" or to statistics of later date than 1913, and the substitution of several minor illustrations by others not too incongruous with Franco-German relations in 1923. The lack of an index in a work of this kind is also to be regretted.

In the foreword to "A Practical Method for Determining Ocean Currents" Lieutenant-Commander Smith states that it was compiled from a series of lecture notes made while the author was taking an advanced course in oceanography under Prof. Björn Helland-Hansen at the Geo-Physical Institute, Bergen, Norway. It is

an exposition of the dynamic methods developed by the Scandinavian oceanographers—Bjerknes, Ekman, Sandstrom, Helland-Hansen, and others—for studying ocean currents. After a brief discussion of the forces involved in the production of currents, the author shows how from a knowledge of the temperature and salinity of the waters at various depths at several stations the velocity and direction of the current can be computed. The discussion is elucidated by examples taken from the observations of the International Ice Patrol. Within the compass of its fifty pages this publication gives the first adequate account in English of the procedure which must constitute the primary method in the study of oceanic circulation.

While dealing with the ocean from different points of view the four publications reviewed above have one character in common—it is with the ocean in general that they are concerned. In contrast, Dr. Schott's "Geographie des Atlantischen Ozeans" constitutes a regional geography of an area focusing in an ocean basin. Beginning with a historical chapter on the discovery of the regions facing the Atlantic, Schott then discusses the area, limits, and configuration of this ocean; the geological features of the region; the characteristics and movements of the waters; the climate and life of the ocean; and concludes with a chapter on "Man on the Atlantic Ocean." Natural regions in this area are stressed in connection with climate and with the physical characteristics of the waters.

The first edition of this admirable reference book appeared in 1912 (reviewed in *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913, pp. 378–380), and in this second edition the high standard is maintained. The subject matter has been revised in the light of the most recent knowledge, the excellent bibliographies following each chapter have been brought up to date, certain sections have been completely recast, and several new ones added. Wegener's hypothesis appears in connection with the discussion of the origin of the Atlantic Ocean; the section on types of coasts and harbors is enlarged; a section on tides has been added; the chapter on life in the Atlantic Ocean has been completely rewritten and is from the pen of Dr. E. Hentschel; the last chapter, dealing with man's relations to the Atlantic, has been recast, and a section devoted to the geopolitical status of the Atlantic Ocean added.

Dating the entrance of the Atlantic on the political scene from the discovery of America, Schott epitomizes its changing status into five epochs which he denominates, respectively, the Portuguese-Spanish, the Dutch, the Franco-British, the British, and the British-American—its present status. In his opinion, however, this dual hegemony cannot continue permanently but is bound to be followed by a purely American (United States) epoch.

As a highway of commerce and intercourse the Atlantic is the principal ocean. Schott directs attention to the fact that it carries more than twice as much shipping as the Indian and Pacific Oceans combined. The oft repeated assertion that the Pacific is to supersede the Atlantic as the principal sea of commerce and of world events, Schott regards as unwarranted by the facts; and he says that "the Pacific Ocean suffers not merely from its size but also from the geographic fact that the countries on its eastern rim have their backs toward it, so to speak."

H. A. MARMER

RELATIONS BETWEEN CANADA AND THE UNITED STATES

ROBERT FALCONER. **The United States as a Neighbour from a Canadian Point of View.** viii and 259 pp.; map, index. University Press, Cambridge, 1925. 8s. 6d. 7 x 5½ inches.

There is drawn in this book an excellent sketch of the major problems that confronted Canada in the period of growth to nationhood. The early difficulties of the scattered provinces acting as separate units and not as an economic entity are forcefully presented. The small size of Canada in contrast to the wealth and power of

the United States, the fact that she is to a large degree composed of two races with different religious creeds, and that the geographical disposition of the best country and the densest population makes it more natural for her separate units to trade region by region with the United States—all these difficulties have had to be overcome or partially offset first through confederation and the building of a transcontinental railway system, second, through the devotion and sustained faith of nationalists who looked upon the place of Canada within the British Empire as a much more important asset than union with the United States. Indeed, the growth and the persistence of loyalist sentiment in Canada is one of the least understood things in our country and is here intelligently presented as one of the most persistent qualities of political life in Canada.

One chapter deals with the boundary disputes between Canada and the United States and the manner in which they kept alive the bitterness that began with loyalist expulsions and confiscations during the Revolutionary War. Similarly, the fisheries and Bering fur-seal disputes have been sources of resentment. But the point is made that while all of these questions were frequently acute and Canada forced to agree to most treaties to her disadvantage, a war was never provoked by them and no permanent resentment has fastened itself upon these two neighbors. The line of the boundary is not so important now as the use of common resources upon it, as, for example, the waters of the Great Lakes for power and transportation and that of the Milk River for irrigation. The happy results of the work of the International Joint Commission are emphasized—twenty-five unanimous decisions since 1912 affecting interests of wide scope and economic importance. The power of the Commission is so great, as fixed by treaty, and the sentiment behind it in both countries so sincere that it has become one of the major international bodies of our time.

Among specific questions that receive fresh treatment are the growth to economic independence despite a closer and closer business relation to a much more powerful neighbor; the composition of the people of Canada and how it has been affected by streams of settlers from Canada to the United States in the East and from the United States to Canada in the Northwest; French-Canadian culture; and Canadian sentiments and opinions with respect to the social structure, the church, imperial policies, and the special conditions brought about by the World War.

Relations Between Europe and America in the Agricultural Field

Edwin G. Nourse. **American Agriculture and the European Market.** xvii and 333 pp.; diagrs., index. (Inst. of Economics, Investigations in Agric. Economics.) McGraw-Hill Book Co., Inc., New York and London,.1924. $2.50. 7½ x 5 inches.

Altogether admirable is the clear and forceful analysis here presented of the relations between European and American agriculture. Every geographer would do well to study the whole book closely, for he will find there available in compact form descriptions, statistics, and analyses of primary importance in world trade. It is made clear that the reference to 1914 as a normal year to which post-war conditions may safely be referred is erroneous and that a longer view must be taken in order to see not merely what *was* but what *was developing* in 1914 (p. 231).

After brief references to English colonial policies which meant the encouragement of the products of the southern colonies supplementary to British products and the discouragement by trade acts of the products of the northern colonies the course of American agriculture is traced through the period of the Civil War and down to 1914. Our relatively sparse population and rich and ample soil gave us an extraordinary position as the feeders of the dense populations of Europe which had an

inferior soil. So western Europe became the workshop of the world, and the United States became its granary—and in addition its live-stock farm and cotton plantation. Whatever help this gave us, it was also true that European industrialism was helped by our cheap food. After the Civil War came a steady diminution of our free land and our own rapid industrialization. The result was that domestic consumption tended more and more to overtake home supply in the years just before the European War. Remarkably forceful are the statistics in showing the steadiness of this decline from 1900 onward. Europe turned in larger and larger measure to newer or less industrialized areas—Argentina, Canada, Russia, and Australia. The World War greatly stimulated our agricultural production. War prices tended to overcapitalization, and the end of the war meant the collapse of the European market.

The author traces in rapid style the course of events in one European country after the other, and his analysis clearly shows that relief for depressed American agriculture cannot come from European sources. We can best present his findings by quoting the concluding paragraph.

"We conclude that, as a prosperous Europe in the position of a heavy creditor of the United States was declining in importance as a market for our agricultural products at pre-war price levels, a less prosperous (not to say crippled) Europe, shorn of her credits here and our debtor on a tremendous scale, can not be expected to be a good market at present and prospectively higher levels of costs. Hence, agricultural exports may be expected to drop still further in 1924 and thereafter. For American agriculture to plan her future building on the foundation of an expected revival and growth of the European market would, therefore, mean building on quicksand."

The Great Regions of France

Emmanuel de Martonne. **Les grandes régions de la France: Description photographique avec notices géographiques.** With the collaboration of Paul Feyel and Maurice Teissier. **Région méditerranéenne.** 32 pp.; maps, ills. **Cévennes et Causses.** 31 pp.; maps, ills. Payot, Paris, 1925. 15 fr. each. 6 x 9½ inches.

The distinguished professor of physical geography at the Sorbonne here offers us two of a series of ten photographic albums each of which will treat one of the great provinces of France. That these little books are to be very different from the ordinary run of publications issued under the name "album" is quickly apparent. Instead of pictures of historic monuments, famous buildings and similar features, we find landscapes typical of the region under treatment, revealing how geological conditions and the forces of nature have determined the characteristic scenery of the country. Man's contributions to the landscapes are not ignored, however. There are illustrations of types of culture and views of cities, some of the best of the latter taken from airplanes. The illustrative value of the pictures is assured by the fact that many were taken by geographers, who selected the points of view with much care; while the airplane photographs were made especially for the album under directions furnished by the author. The pictures are accompanied by brief descriptive texts, and both together give the reader an excellent mental image of the region treated. Maps show the locations of all places mentioned, and in addition there is an indication of the French topographic sheet upon which the area pictured will be found.

The first album issued deals with the Mediterranean region and comprises sixty-one plates with some two dozen pages of text. For variety of forms the region is well chosen to introduce the series; for the maturely dissected mountains of southeastern France, the gently sloping plain at their base, the rivers flowing in narrow gorges or wandering aimlessly amid countless sand bars on broad flood plains, and the youthful shore line with its bars, deltas, rocky peninsulas, and islands are the subjects of a succession of pictures remarkable alike for their scenic beauty and

their scientific interest. Geographers will wax enthusiastic over the airplane views of the ports of Marseilles and Cette with their basins, of the double *tombolo* of Giens, of the braided Var River, and the "close-up" views of the curious weathering forms in granitic rocks known in Corsica as *tafoni*. And where will the ordinary traveler find such admirable views of Carcassonne, Aiguesmortes, and Monaco as the airplane pictures made for this album? When one remembers that the significance of the features shown is explained in non-technical language by a geographer of international reputation, aided by two capable associates in geography and history, he will agree that the new series of albums should prove most useful not merely to those scientifically trained, but to all who are interested in La Belle France.

In this second volume, dealing with the "Cévennes et Causses," the geographic unit widely known as the "Massif Central" is first described, and its four subdivisions named. Two of the latter, the Limousin and the Auvergne, are reserved for later treatment. Here the high, rugged southeastern portion of the Massif Central known as the Cévennes, and the southern areas covered with limestone known as the Causses, are described in detail and illustrated with numerous excellent photographs. The picturesque spurs and deep valleys of the one, the steep-walled plateaus, rocky canyons, caverns, sink holes and natural arches or bridges of the other, form the subject of some dozens of instructive geographic studies. Incidentally one learns something of the modern home of Roquefort cheese and of the prehistoric dwelling places of early man.

DOUGLAS JOHNSON

A FRENCH REGIONAL MONOGRAPH

ANDRÉ DAVID. **La Montagne Noire (Aude, Hérault et Tarn): Essai de monographie géographique.** With preface by Emmanuel de Martonne. 226 pp.; maps, diagrs., ills., bibliogr. *Mémoires Soc. d'Études Sci. de l'Aude*, Vol. 2. L. Bonnafous, Carcassonne, 1924.

Beyond the limestone table-land of the Causses the Cevennes are prolonged towards the southwest by a massif which by its well-defined characteristics is sharply distinguished from the surrounding regions. This little geographical entity, the Montagne Noire, is the subject of a monograph by André David, a student of the École Normale Supérieure, who was killed early in the war and whose work has now been put into shape and published. Professor de Martonne has written a preface, and M. Léo David, father of the author, has furnished panoramic sketches. These illustrations merit special comment: altogether 100 were made, forming an iconography the like of which does not exist for any other French region. Those not reproduced in the volume are on file at the Sorbonne.

The topography of the Black Mountain is varied: the southern border overlooking the plain of Lower Languedoc is cut up by deep gorges; the center appears as a little-dissected plain. The author has recognized a series of erosion cycles, special interest residing in his demonstration of a fossil peneplain (pre-Eocene) which extends over all the southern part of the Black Mountain. The opposition between south and north is marked as regards distribution of winds and rainfall. Blowing over the Mountain from south to north and vice versa, winds change their characteristics and names: the *cers*, humid in the north, is transformed into the dry *transmontane* of Languedoc; the *marin*, humid and soft in the south, becomes the dry and violent *autan* on the north. The north is open to Atlantic influence; the south to Mediterranean. The vegetation reflecting these varied influences is correspondingly varied, and the author devotes an interesting chapter to this important subject.

On the economic side of the study special reference may be made to the treatment of the industrial evolution of the region. Here the local production of wool and the

presence of numerous streams have encouraged the textile industry from early times. After 1830 the industry took on considerable importance. Local sources of material became insufficient, and in 1851 importation began from the La Plata region. Thanks to good equipment and excellent organization the industry has continued to prosper.

Valuable notes are given on house types and villages and on the population and its movements. In sum, the work of this young author, though not a finished study, is an excellently conceived monograph of a type all too rare in geographical literature.

M. LEBRUN

TURKEY AND CONSTANTINOPLE

GEORGE YOUNG. **Constantinople.** vii and 310 pp.; map, ills., index. Methuen & Co., Ltd., London; George H. Doran Co., New York, [1926.] $5.00. 9 x 6 inches.

A. J. TOYNBEE AND K. P. KIRKWOOD. **Turkey.** xiv and 329 pp.; maps, bibliogr., index. (The Modern World: A Survey of Historical Forces, Vol. 6.) Ernest Benn, Ltd., London, 1926. 15s. 9 x 6 inches.

> "*Master of the Caravan:*
> Open the gate, O Watchman of the night.
> *Watchman:*
> Ho, travellers, I open. For what land
> Leave you the dim-moon city of Delight?
> *Merchants:*
> We take the Golden Road to Samarkand."

With these lines George Young closes his picturesque introduction and gives the keynote of the substantial text that follows. The first part of the book deals with the Roman Empire, the second with the Byzantine Empire, a third with the Ottoman Empire. The final section describes the Turkish nation and covers the period from the Young Turk revolution of 1908 to the present time, with the government transferred to Angora: "no doubt a good place to work; for there is nothing else to do." The period of Roman occupation is told in terms of the oldest architecture of the city, that of the Byzantine Empire in terms of its walls, whereas the Osmanli Empire story is bound up with the mosques and bazaars of Stamboul and the lives of its sultans. Under the Romans Constantinople grew until it drew into its markets the wealth of the known world "from China to Caledonia and from Scythia to the Sahara." Thus its history is related to many of the vicissitudes of world history. Every major event of the Black Sea coast was registered here, Greeks and Romans struggled for its possession, Turk and Christian besieged it. Peter the Great and Catherine after him made it a prime object of empire. The trade of Genoa and Venice was largely dependent upon it, and throughout its whole history the shipping of these two cities has passed its gates or lain in its harbor. Even during the Osmanli Empire the association of Constantinople with the Italian cities continued. The Turks broke at last with Venice, and this break but shortly preceded Lepanto and the crushing of Turkish sea power.

Because Constantinople was the greatest of medieval marts the Turkish sultan could well style himself "Lord of the Upper and Lower Seas." He threatened to invade Germany and even France: "to our forefathers Constantinople was a word of terror." In the history of Constantinople we may find a reason for the development of silk culture in Anatolia when the heavy customs duties under the later Roman rulers retarded commerce and the import of silk from China died off only to have the culture of the silkworm taken up on home territory and be continued down to the time of the expulsion of the Greeks a few years ago. Those extraterritorial privileges, the capitulations, we see not as a modern development only but one that

reaches back for more than a thousand years as foreign colonies were established by the Turks who forcibly brought in Greeks from Thrace and Trebizond and thus restored the city to its position as the center of world commerce, offsetting the destruction wrought in its capture and the decay it suffered in the later Byzantine period immediately preceding Turkish occupation. Just as the aqueduct and cistern built by Valens are still in use and traces of the Anastasian wall may still be seen, every period marked by its own peculiar culture, so the capitulations come down with many mutations to our own time. They were not due to the administrative incapacity of the Turk but were built up consciously as an international institution, seemingly the best arrangement that could be made in a city that was destined by nature and history to be a great international commercial center.

Though the greater part of the contents of the book on Turkey, as well as the interests of the authors, are historical, there is a goodly quantity of material of geographical value. Moreover, the geographer who wishes to understand the new state of Turkey would do well to read so important and interesting an account of its historical development.

Turkey's history is largely a record of the clash of cultures and civilizations upon Turkish soil as the Central Asiatic invaders moved westward to control a native peasantry over which Persian, Greek, and Roman had successively held sway. Still more important was the stride by which the leaders crossed into Europe and maintained themselves in power athwart the great arteries of communication between the different parts of the Near East. The withdrawal of the government to the interior town of Angora in the present régime has of course greatly stimulated the growth of that small provincial city, but this is offset by a decline of greater magnitude in Constantinople, which was so long the religious, strategic, and cultural center of the Ottoman Empire and the hope of Islam. Constantinople is now a distant seaport town, and if its neglect continues Smyrna, which formerly led in exports and was second in imports, will become the leading city.

Realizing that Turkey is not an industrial state and that agriculture is almost the sole support of the people, the new government has shown a progressive spirit in introducing modern agricultural implements, establishing agricultural schools, and carrying forward a campaign of agricultural propaganda. It has also extended special privileges to industry in order that Turkey might enjoy some measure of independence with respect to imported manufactures. The government is still faced with the problem of attracting foreign capital in order to extend the railways, which, next to agriculture, have been the chief object of solicitude. With her outlying territories cut off and the attention of her leaders concentrated upon domestic problems, with western breezes blowing through the country, and particularly with the modernization of the codes of law, Turkey promises to emerge at last from its medieval state and become a modern power.

The Economic Development of South Africa and the Belgian Congo

M. H. de Kock. **Selected Subjects in the Economic History of South Africa.** ix and 475 pp.; maps, diagr., index. Juta & Co., Ltd., Cape Town and Johannesburg, 1924. 15s. 9 x 5½ inches.

In the early days of the development of South Africa as a home for white men the political and social problems, if not simple, at least had simple solutions applied to them. The relation of white to native was much less a matter of concern, the mineral and pastoral riches of the country offered such extraordinary rewards, and frontier trading allowed such high profits to the venturesome that the eyes of governments and colonists were fixed upon the future rather than upon the present.

The addition of German Southwest Africa, the definite fixation of boundaries and mandates, and especially the termination of the special privileges enjoyed by

the great trading companies, mark the full opening of a new and highly complex stage. The author of this book traces the steps by which the white man has come into his present inheritance of resources and troubles, and he does it in a thorough manner with excellent technique and that highly specialized knowledge in the various sciences which a community with varied resources has to take account of. He deals thoroughly with forests and mines, farms and orchards, shipping and railroads, labor and capital, banking, taxes, and last and most acute of all, the "poor white" problem, which he shows is fundamentally a rural problem since the great bulk of the poor whites are Dutch-speaking and of rural origin. In recent years the poor white problem has become also an urban problem because of growing industrialism and the drift from the country to the town. The problem has been complicated by the competition between white and colored in the unskilled and semi-skilled occupations in urban industries and the lack of any real industrial education. The problem has been dealt with still more fully in the lectures by Professor W. M. Macmillan entitled "The South African Agrarian Problem and Its Historical Development," Johannesburg, 1919. While the old style drift of the pioneer, or trek Boer, into the remote and undeveloped districts of the Northwest and Bechuanaland continues, the chief movement is from the drier areas to the coast belt and the low veld (p. 87). Macmillan touches the heart of the problem of the poor white in showing how the trek Boer became the normal type. His farming was extensive rather than intensive, he roved for roving's sake, there were no facilities for education, even the tradition of learning was destroyed. Now that intense competition has come through increase of population, and land is no longer easy to get, the ignorant farmer has little chance, and he presents one of the major problems of the Union.

La politique économique au Congo belge: Rapport au Comité permanent du Congrès colonial. v and 333 pp. (Bibliothèque-Congo [Publ.] No. 15.) Goemaere, Brussels, 1924. 10 x 6½ inches.

By a series of political steps taken during the last third of the nineteenth century, Belgium became in a sense the trustee in the first instance of that immense tract of tropical territory now known as the Belgian Congo. If mistakes have been made in administration it must also be said that on the whole relations both with the natives and with the bordering powers have markedly improved. The political and economic geography of the region is made the subject of this monographic report, which deals not only with the statistics of production and exchange but with industry in all its phases from the small rural establishments to those that work under government aegis. Extensive is the effort of the state to penetrate to the life of the native villages, to improve their methods of production, to balance the organized life region by region so that one industry may not prosper at the sacrifice of another. The forests, the mines, pasturage, horticulture—all these are treated exhaustively. The report is written in the spirit of development and with an eye to the future and deals rather with the facts and the future of material development than political policies.

Health in the Tropics: Northeastern Amazonia

R. P. Strong, G. C. Shattuck, J. C. Bequaert, and R. E. Wheeler. **Medical Report of the Hamilton Rice Seventh Expedition to the Amazon, in Conjunction with the Department of Tropical Medicine of Harvard University, 1924–1925.** xvi and 313 pp.; map, ills., bibliogr., index. (Contribs. Harvard Inst. for Tropical Biology and Medicine, No. 4.) Harvard Univ. Press, Cambridge, Mass., 1926. 10½ x 8 inches.

To the uncritical, every advance in tropical medicine is hailed as a crossing of one of the last barriers to white occupation and exploitation of the tropics. The modern sanitation methods now employed in tropical cities of Central and South America

have steadily driven out, or reduced to manageable scope, perhaps the most dreadful of tropical diseases, yellow fever. The reports, and especially the maps, published by the Rockefeller Institute show this clearly. But no amount of medical research can lessen the ardor of the tropical sun, no man-created agency has been able to conquer in a practical way the overwhelming pest of insects, no necromancy can combat the tropical rainfall. The seasons, like the tides, are immutable, and as concerns white occupation of the tropics their effect upon human physiology is of equal importance with advances in medical science.

The above report, while chiefly concerned with technical medical matters, contains some arresting paragraphs bearing on the geographical side of the question. It opens with a chapter on the Amazon forest that is particularly valuable because written from the medical man's point of view. Two paragraphs from it deserve quotation because they give in compact form a statement to which heed should be given by every optimist in tropical development.

"The virgin forest of the Amazon offers little hospitality to the traveller, and it has perhaps been appropriately named by Alberto Rangel the *inferno verde*, where one soon dies of hunger, and during the dry season suffers from thirst, when almost all the streams which traverse it are reduced to some few puddles of stagnant or brackish water. It is too thickly and too regularly grown to be grand or picturesque, and too silent to be cheerful. It breeds too much vermin to be agreeable, and produces at length upon the traveller vague sensations of sadness, oppression, and uneasiness, which cause him to breathe a sigh of relief or to cry out with joy when chance conducts him to some *campinarana*, or small prairie, or when he reaches the sunny banks of a stream with billows tumbling among the rocks of its yet imperfectly excavated bed" (p. 10).

"The natives of Amazonia outside of the cities and towns live usually in small groups of palm-thatched huts, situated on the banks of the rivers or small streams, but occasionally located inland in the forest which has been cleared in their vicinity. The conditions of life in these settlements are most primitive. None of the houses is screened, nor are mosquito nets, except in very exceptional instances, used at night. The natives are exposed both night and day to the bites of all insect life. No hygienic measures are taken by the inhabitants of these localities in the disposal of excreta, the care or sterilization of drinking water, or other precautions against disease. There are no physicians and no drug or chemists' stores outside of the cities. Generally speaking, the inhabitants living upon the river banks show evidence of either acute or chronic disease, or the effects of having suffered from such disease. Portions of Amazonia to-day constitute some of the most unhealthy and most dangerous regions to reside in, from the standpoint of health, that exist in the tropics" (p. 13).

In every section of the report are equally important statements as, for instance, in Part II where Joseph Bequaert writes of medical and economic entomology. He here describes the characteristics of the evergreen rain forest, its ecological types, the seasonal habits of the rising and subsiding waters, and the nature of the insect pests. His meteorological observations on the upper Rio Branco are particularly important. The rôle of the ants in tropical economy should also be mentioned especially (p. 180). Shattuck's "Observations on the Branco, the Uraricuera and the Parima Rivers" are noteworthy because of the fact that we are here in a climatic province that departs from the true Amazonian type. His notes on the vegetation and the population and his medical observations upon them give one an admirable insight into the terrific handicaps of tropical life in this distant frontier.

All of the descriptions of the Amazon country in the report should be read with frequent attention to the map, for, while Amazonia is a term frequently used, the observations of the writers were confined to but a part of this vast realm; so that not all of the generalizations are to be taken as applying to the whole of Amazonia.

The Volcanoes of Central America

Carlos Sapper. **Los volcanos de la América Central.** 116 pp.; ills., index. (Studien über Amerika und Spanien, Extra Series, No. 1.) Max Niemeyer, Halle, 1925. M. 8. 9½ x 6½ inches.

Carlos Sapper. **El infierno de Masaya.** 65 pp.; ills. (Studien über Amerika und Spanien, Geogr. Series, No. 2.) Max Niemeyer, Halle, 1925. M. 4. 9½ x 6½ inches.

The University of Würzburg is undertaking a series of monographs in Spanish, on Spanish America, of which the above are the leaders. The first is based on Dr. Sapper's well known book of 1913 on the same subject, with some additions due to later observations by himself and others. The author gives a general account of the volcanoes with a list of the more important ones, their geographical positions, and eruptions. This covers 22 pages. The rest of the monograph consists of descriptions of individual volcanoes and their histories. The descriptions are mainly physiographic, but some account is given of the petrology. There are some good halftones of volcanoes in eruption, but the actual phenomena of the eruptions are not described. A map showing the relative positions of the volcanoes would have been a real help to the reader.

When the Spaniards invaded Central America early in the sixteenth century, they were greatly impressed by the volcano Masaya, in Nicaragua. This volcano is of special interest because at that time it contained a lava lake, which Sapper tells us was quite similar to the present lava lake of Kilauea. It has long since disappeared. Some of the Spaniards thought that here was an opening into the lower regions; others thought the liquid lava contained gold and silver. After a few pages of introduction dealing with the earlier and the modern observations and the sources of information, nine of the early documents are reprinted. They were all written in the sixteenth century, and apparently all refer to visits made to the volcano in the first half of the century or very little later. Vulcanologists will be grateful to Sapper for making these documents accessible; beside their general historical interest they will show, by comparison with modern accounts, what changes have taken place in the last four hundred years.

Harry Fielding Reid

A New Theory of Volcanism

Arthur L. Day. **Some Causes of Volcanic Activity.** Ills. *Journ. Franklin Inst.*, Vol. 200, 1925, pp. 161–182.

Arthur L. Day and E. T. Allen. **The Volcanic Activity and Hot Springs of Lassen Peak.** 190 pp.; maps, diagrs., ills., index. *Carnegie Instn. Publ. No. 360*, Washington, 1925. 12 x 9 inches.

The studies of Kilauea and Lassen Peak, which Day and his colleagues have been pursuing for some years, have borne fruition in a new theory of volcanic eruption, which Day has set forth in his address before the Franklin Institute. He presents his facts and makes his deduction in such a logical and lucid manner that he is quite convincing. He recalls Jaggar's observation that the lava in the lake on Kilauea is 100° C. hotter at the surface than 20 feet below; he describes the gases collected near the surface of the lake, and shows that chemical reactions, with the evolution of heat, must be taking place between them; and the natural deduction is that the high temperature of the lava is due to these reactions. When the lava lake sank 700 feet in 1924 it laid bare the conduit; the rocks at the bottom were crystalline and not glassy; they were not solidified lava. And when the lava again poured into the conduit, it did not rise from the bottom but poured in from several points well up

on the sides. The gases collected even from the same vent near the lake were in different proportions at different times. These observations, together with the known independence of level of the lava in Kilauea and in Mauna Loa, lead to the conclusion that the two are not connected but are independent systems each fed by lava from a number of independent pockets, and the gases in the lava from these pockets differ in composition. The pockets are considered unsolidified spots in a slowly cooling earth. By the analyses of the gaseous content of rocks Day is led to the conclusion that the magma in the pockets is slowly crystallizing and giving off gases. If the gases are principally water vapor, as was true at Lassen Peak, the pressure will gradually rise until there is an explosive eruption at a relatively low temperature; if other gases, which react chemically, predominate, the temperature will be high, the rock will be melted, and lava will flow. Day firmly rejects the idea that volcanoes are safety valves connected with a central reservoir, or that they are due to some special source of heat, such as radium. On the contrary, they are phenomena due not to heating but to gradual cooling; he reaches the conclusion in his own words, "that volcanoes are local and superficial developments representing (geologically) the last stages of crystallization in a mass of magma below, of which little remains fluid, and this in small (as geologic dimensions go) pockets, which are quite variable in gas content, pressure, and conditions of chemical equilibrium." These views are certainly revolutionary; but I believe they will hold.

The monograph on Lassen Peak, with its many beautiful illustrations, gives the history of the eruptions of that volcano since 1914; it gives in detail field observations and laboratory studies, analyses of rocks and gases, temperatures and changes of the hot springs. The immense quantity of water vapor given off in the eruptions are considered to be principally magmatic, whereas the water of the hot springs is thought to be principally meteoric, heated by water vapor ascending from the hot magma below. The book is full of definite information and is an important contribution to volcanic literature. The conclusions reached, bearing on the general theory of volcanic action, are mentioned in Day's address before the Franklin Institute.

HARRY FIELDING REID

GLACIAL PERIODS IN THE EARTH'S HISTORY

A. P. COLEMAN. **Ice Ages, Recent and Ancient.** xliii and 296 pp.; maps, ills., bibliogrs., indexes. The MacMillan Co., New York, 1926. $4.00. 9 x 6 inches.

The number of the ice ages in the earth's history accepted by Coleman is 11, but a few of these are regarded as somewhat doubtful. The geological periods of extensive glaciation are, in direct order: Keewatin, Timiskamian, Huronian, Animikian, Keweenawan-Cambrian, Ordovician, Silurian-Devonian, Carboniferous-Permian, Triassic-Jurassic, Eocene, and Quaternary. Four ice ages stand out from the rest by their great intensity, viz. the Permo-Carboniferous, Keweenawan-Cambrian, Quaternary, and Huronian, mentioned in order of importance.

None of the hypotheses advanced as to the causes of extensive glaciation is considered adequate to explain the localization of the glaciations, the alternation of glacial epochs and interglacial periods, etc. No single theory is advanced, but it is suggested that a conjunction of a number of conditions, astronomic, geologic, physiographic and atmospheric may be necessary to produce such catastrophic events in the earth's history. The reviewer agrees heartily in this.

The work shows the importance that the ice ages have played for the earth and its inhabitants. It points out how the discoveries of extensive glaciations in the remote past have fundamentally changed old conceptions of high temperature during those ages.

Personal study of glacial formations of all ages in all parts of the globe, about

which the matchless collection of tillites, glaciated boulders and ledges, varved slates, etc., in the Royal Ontario Museum, Toronto, bear witness, has made Professor Coleman the foremost authority on the subject; and as a consequence this excellent and beautifully published treatise is of exceptional value.

ERNST ANTEVS

A THEORY OF THE DOLDRUMS

C. S. DURST. **The Doldrums of the Atlantic.** Map, diagrs. *British Meteorol. Office. Geophys. Memoirs No. 28 (Eighth Number of Vol. III)*, pp. 229–238. London, 1926.

These are times in meteorological investigation when more and more attention is being directed to fluctuations—seasonal, annual, and in longer periods—in the great wind and calm belts, and in the "centers of action," of the general circulation of the earth's atmosphere. This circulation may best be thought of as a machine. It does not "run true" to "normal" but is subject to fluctuations which often involve variations in seasonal weather of great economic importance.

In the present monograph the author discusses that most interesting of all the wind and calm belts of the world, the doldrums—the region of calms and light variable winds within the equatorial trough of low pressure between the trades. Mr. Durst has made a thorough study, by means of isopleth and other diagrams, of the characteristics of this belt, using all available data. The doldrums are found to vary considerably in their position, and these fluctuations are associated with variations in the humidity of the trade winds. The generally accepted theory is that the high temperatures near the equator cause the air there to expand; air moves away polewards; a low-pressure belt results, and convection then produces the characteristic clouds, squalls, and rainfall. The author finds that the maximum temperatures seem to have less to do with the seasonal variations in the position of the doldrums than do the maximum pressure and the maximum humidity. He, therefore, suggests an alternative theory, "that the heat energy of the sun is stored by evaporation in the trade winds and this energy is released by convection (started either dynamically or thermally) in the doldrums." Convection results in the movement of the air polewards; the pressure gradient towards the doldrums becomes steeper, and the trades blow faster. In other words, an increase in the humidity of the northeast trades would tend to move the northern edge of the doldrums northward, "since the same aqueous stage in the air's progress would be reached at an earlier date." The lowest pressure would thus tend to follow the position of the greatest humidity rather than the position of the maximum temperature.

If the author's theory "that the convection of the doldrums is an important factor in the atmospheric circulation" is correct, the rainfall of the doldrums is a "direct expression of the energy released in the conversion of water vapor and must be related to the forces which govern the general circulation." A numerical relationship of this sort is found between the energy released in the doldrums and the energy that is dissipated by turbulence in the general circulation.

Mr. Durst's paper is interesting and suggestive. Although he makes no reference to the possible future use of his conclusions in relation to long-range forecasts, it is natural that the thought of his readers should run in that direction.

R. DEC. WARD

REPRODUCTIONS OF EARLY MAPS

G. CARACI. **Tabulae geographicae vetustiores in Italia adservatae.** Vol. I, 18 pp. of text and 20 pls. in portfolio. Otto Lange, Florence, 1926. 20 x 14 inches.

These maps are reproduced and explained as a contribution to the history of geographical knowledge in the period of the great discoveries. The present volume

contains seven maps: a world map by Lopo Homem (1554); a map of Europe by Diego Homem (1563); a map of North and South America by Paolo Furlani (1574); an anonymous English map of the east coast of South America thought to be derived from the Cavendish expeditions to the South Sea; an Englishman's (Gabriel Tatton) map of the Pacific (end of the sixteenth century); Cornelis Doetz's map of the Indian Ocean (end of the sixteenth or beginning of the seventeenth century); and a map of the North Sea by Evert Gysbertsoon (1601).

None of these maps can lay claim to the importance attaching to the Behaim globe of 1492 or to the great Waldseemüller maps of 1507 and 1516. Neither can they excite the interest aroused by the La Roncière map two years ago. However, Signor Caraci's volume does rival both in importance and interest the contemporary work of Dr. F. C. Wieder. It is an important step towards making easily accessible to scholars all of the maps remaining to us from the period of the great discoveries.

Maps by their very nature become obsolete. This fate overtook them more rapidly in the great discovery period than it does today. In the period between obsolescence and their being sought as valuable historical records map mortality is very high. Many thousands of these precious historical records have now been lost forever. The most valuable maps of Columbus and his successors were manuscript maps on separate pieces of parchment. These, unlike the printed map bound in a book, had nothing but their own value to cause them to be saved; and the few that, by various happy accidents, have remained to our day are more inaccessible than the printed maps.

Historians were early confronted with obstacles in properly using the great cartographical records of discovery and exploration. Governments were very jealous of the secrets of their enterprises especially as revealed in maps. As a result writers, down to recent years, have relied almost exclusively on public records, contemporary letters, and secondary sources and as a rule have either not used contemporary maps at all or have employed them as curious pictures. Among American historians Justin Winsor may be noted a conspicuous exception to this statement.

One of the greatest difficulties of the historian is to avoid interpreting the past in the light of present knowledge. Public records, letters, and books are peculiarly liable to be so misinterpreted. Old maps are freer from the danger of being so misused than any other form of historical record. Therein lies part of their peculiar value. The insertion of old map reproductions in histories also enables the reader to sit in judgment with the historian without filling the work with disjointed material to its detriment as literature.

When a picture is taken with a single-lens camera it is true according to the point of view, but it is a flat record. If, instead, a double-lens camera be employed there is introduced a perspective that gives new meaning to the picture. So there is a new meaning given to the history of the period of geographical discoveries if, to the public records, contemporary letters, and printed books, there be added the reproduction of contemporary maps. Thanks to the work of Santarem, Jomard, Kunstmann, Kretschmer, Nordenskiöld, Fischer, Marcel, von Wieser, Stevenson, Ravenstein, and others, the student of history today is not limited as were the students of other days. But much remains to be done.

Every reproduction of a rare old map is in effect the same as the reproduction of a rare volume of history. Today the students of historical geography are in a position to render obsolete most of the existing histories dealing with the great geographical discoveries. Signor Caraci deserves thanks from students of historical geography. It is to be hoped the succeeding volumes of his work will maintain the high quality shown in the twenty plates of the first. There are unfortunately many errors in the valuable English text. However, they are not of a nature that can detract from the value of the map reproductions.

GEORGE E. NUNN

A Symposium on Population Problems

Louis I. Dublin, edit. **Population Problems in the United States and Canada: An Outgrowth of Papers Presented at the Eighty-Sixth Annual Meeting of the American Statistical Association, December, 1924.** xiii and 318 pp.; diagrs., index. (Publs. Pollak Foundation for Econ. Research, No. 5.) Houghton Mifflin Co., Boston and New York, 1926. $4.00. 8 x 5½ inches.

This book is announced as an outgrowth of a symposium held by the American Statistical Association at its annual meeting in 1924. Its purpose is to give systematic attention to our population problems rather than to explore scattered and minor details. It aims to replace "the prevailing unscientific and almost arrogant attitude on population questions" with a spirit of scientific investigation to the end that a practical and liberal population policy may eventually be developed. Problems dealt with include the growth of population in the United States, its rapid urbanization, its optimum size (as opposed to possible size with a lower standard of living), agricultural and mineral resources and capacities of the United States, national composition, difficulties of immigration and the new restrictive immigration policies, the effect of the employment of women; and the prognostic element is not lacking in a final paper entitled "Trend of Population with Respect to a Future Equilibrium." That Canada is coupled with the United States in a study of the problem is as it should be, seeing that Canada's population is a broad fringe to our own.

The volume is all compact of statistics and other specific elements, as might be supposed from such an origin. It is not without philosophical discussions, and the philosophies naturally do not always agree. However, the student as well as the policy maker of the future will be concerned not so much with the philosophy of the book as with its ideas concerning the relations of people and land, of race to race, and of the specific attempt which the book makes to arrive at a discussion in terms of national policy. This is a healthy sign, for the machinery of knowledge is now so vast that not merely data but the meaning of data and the practical measures which policy makers are to frame and carry out are of immediate importance. If government is to be guided by facts the facts will have to be put in clearer and much briefer form. It would be a great gain if a book of fifty pages could now be written on the basis of this book of 310 pages and if it were made small enough to go in the coat pocket of every congressman.